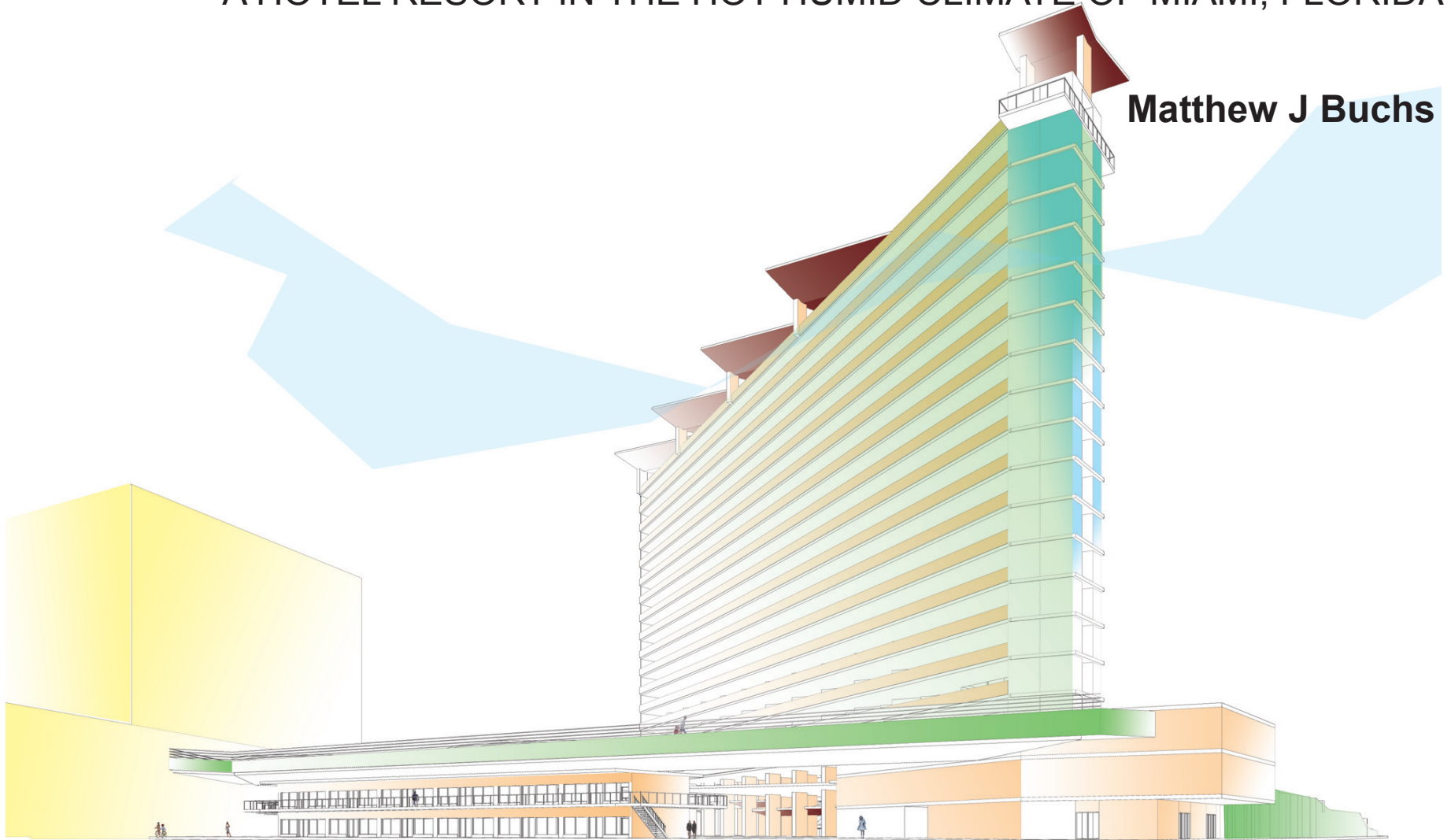


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# NATURAL VENTILATION AS A DESIGN DETERMINANT: A HOTEL RESORT IN THE HOT HUMID CLIMATE OF MIAMI, FLORIDA

**Matthew J Buchs**



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# NATURAL VENTILATION AS A DESIGN DETERMINANT: A HOTEL RESORT IN THE HOT HUMID CLIMATE OF MIAMI, FLORIDA

## [Acknowledgements]

### **Professor Robert Fisher:**

Bob, you have been an inspiration in not only this Thesis, but previous studios. I felt from the first time I participated in your summer studio that I had to have you as a Thesis Professor. Your ability to change my viewpoints, but allow me to freely express my desires has made this year the most productive and successful year of my college career! For this, I thank you.

### **Professor Glenn Sweitzer:**

Glenn, through your exponential knowledge and strength in systems, you guided me to a successful architectural. You constantly drove me to research and test more and more ideas which made my endeavors that much more rich. You also opened my eyes to new ideas and methods I had not yet experienced would not have if it wasn't for you! Much appreciated Glenn.

### **Zachary Benedict:**

I never thought another student could change ones ideas so much. You have given me a completely new outlook on architecture. I have never had someone express ideas and manipulate my thoughts the way you have, and in turn, show me a new path to design. Everything from a simple word to a complex diagram, you could always make it make sense to me.

## **Matthew J Buchs**

**Professor Robert Fisher**  
*thesis studio professor*  
**Professor Glenn Sweitzer**  
*thesis advisor*

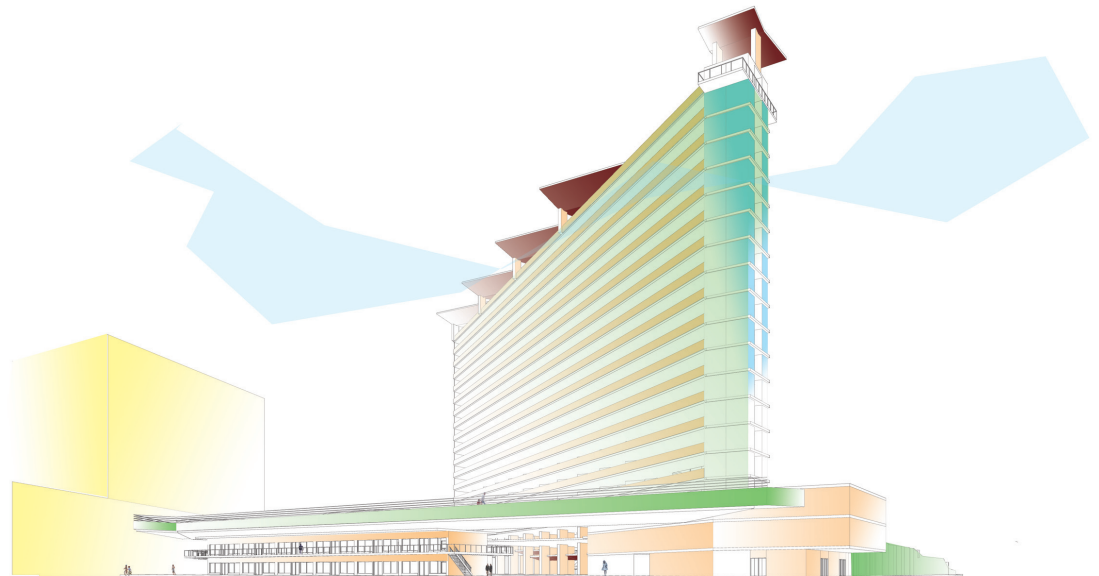


FIGURE [1] Perspective of hotel resort complex

# [Table of Contents]

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[4]-[7] Thesis Background

[8]-[9] Positions and Assumptions

[10]-[13] Contextual Issues

[14]-[15] Program Summary

[16]-[21] Conceptual Design

[22]-[31] Research Analysis

[32]-[43] Design Development and Decision Making &  
Final Thesis Conclusions and Graphics

[44] Reflections and Bibliography

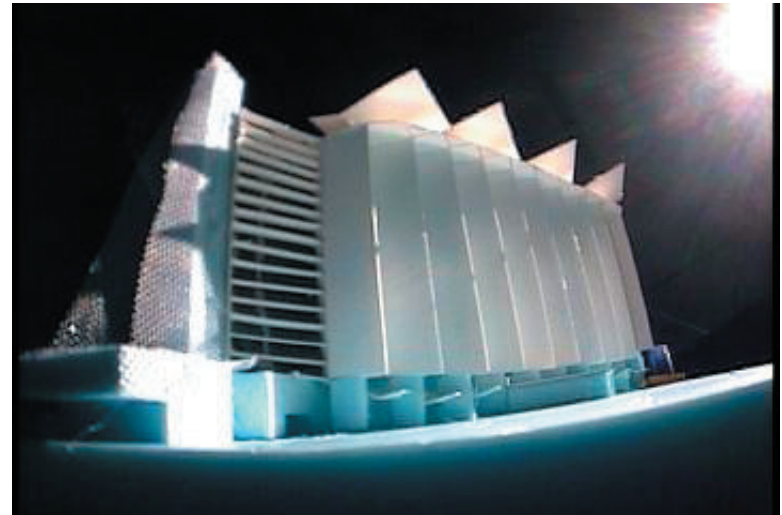


FIGURE [2 &3] Heliodon photographs of massing model study

# [Thesis Background]

Cities of the south, east, and west that dot the ocean and gulf are blessed with an abundance of natural environmental conditions that can be utilized to improve building quality, human life, and reduce energy consumption and costs. I have been a temporary resident of Miami, Florida where beach resorts front the beach and draw vacationers non-stop throughout all times of the year. South Beach is a very popular vacation destination for the young and old. It seems that all these resorts are internally focused using mechanical systems to control the building. The orientations of the buildings do not utilize wind currents, sun paths and the possibilities for day lighting.

The major quest or issue I had to evolve and answer in this thesis was how these beach side resorts can utilize the natural systems that are readily available to the site. I assume that resorts in South Beach work well due to their popularity of location, but I think they can work better and can be a teaching/learning tool for everyone who comes to the resort. I think a resort can be designed for sustainability roles but can be a beautiful architectural piece as well.

The ability to harness mother nature, not turn our backs to her is crucial. The building capacity can increase when the mechanical systems decrease. This decrease can only occur if we, as architects, can change the mind sets of those developing the hotel resort into thinking resourcefully, not wasting what we have available almost year-round.

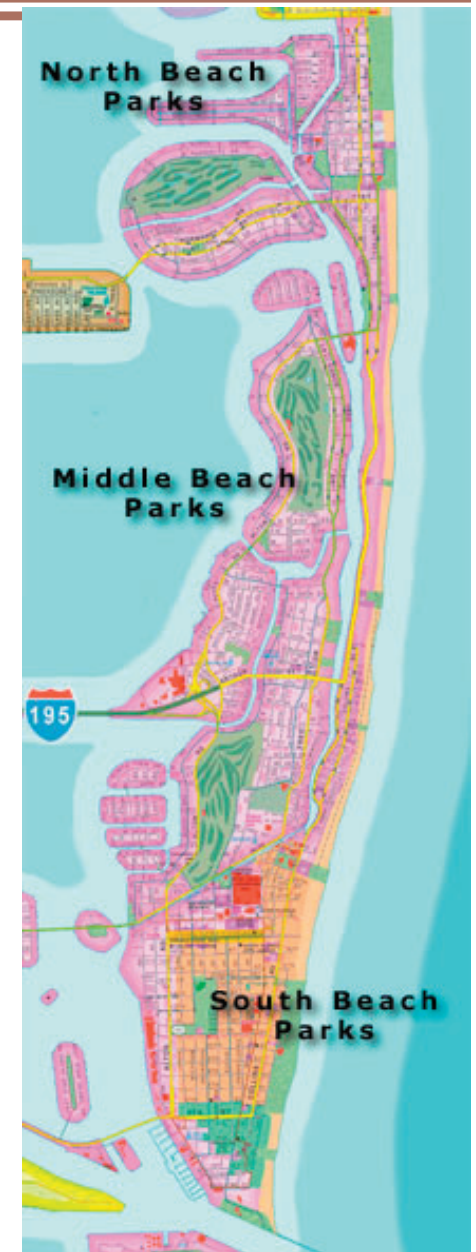


FIGURE [4] Miami Beach park locations

# [Thesis Background]



FIGURE [5] South Beach park locations

It has occurred to me that through my experiences in life that my family, friends, and neighbors would rather have the opportunity to feel the breeze across themselves than have the constant noise of an air-conditioner running. There has always been something about the breeze and the smells of the outside that is more appealing than artificial materials throughout one's home.

At my parents home, the use of natural ventilation has been absolutely key to providing cooling to our home. We have never had any means of mechanical heating or cooling. We rely on the cooler night air to cool the house and by closing our home during the day, it stays cool. That works in our climate of Northeast Indiana, but that won't work completely in the hot and humid climate of Miami, Florida. The cooling load there is constant, therefore a year-round strategy of cooling a hotel resort must be applied. The hotel I stayed in for the semester I studied in Miami constantly had adjacent openings open that allowed the constant breezes that occur because of the heating of the ocean and land. This natural effect kept the lobby space air temperature a bit cooler, but more important it had an evaporative cooling effect on my skin.

I also learned something else from this rather modest hotel. Having a double-sided corridor in which the exterior walls favor one side of the living units for incoming wind, really ignores the other side of the building. I happened to live on the west side of the building, so during the afternoon, intense heat gains were apparent and lack of natural ventilation created a major problem for comfort. Achieving human comfort is the most crucial factor when dealing with hotel resorts.



# [Thesis Background]

## *Questions of a Natural Ventilation Design Determinate*

Now that I have laid down the groundwork for this thesis, there were many questions I had to ask in order to cover a broad spectrum of ideas. These questions were internal thoughts, questions for outside consultants, and questions of ethical relevance.

[1] Is natural ventilation a legitimate design effort in this climate?

[2] Will people be able to adapt to a new kind of thinking about hotel resorts?

[3] Can one new hotel resort change the mind set of the rest of the industry?

[4] What tools are needed to redefine our field of vision and how can I utilize them.

[5] What are the site conditions and how can I harness the specific qualities that will drive a sustainable design?



FIGURE [6] View of thesis site from beach

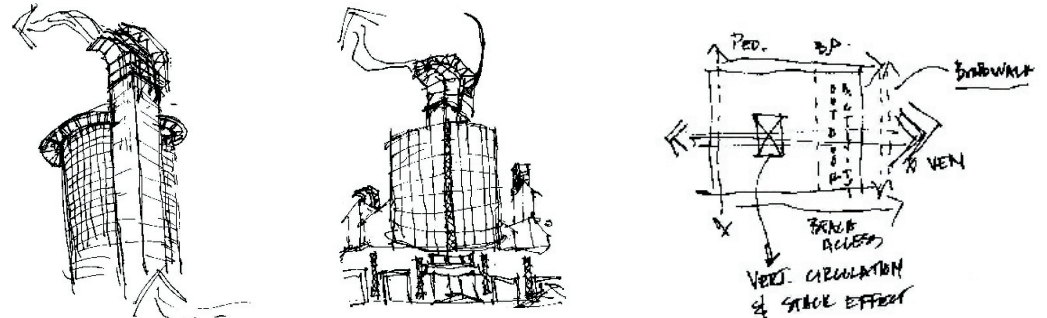
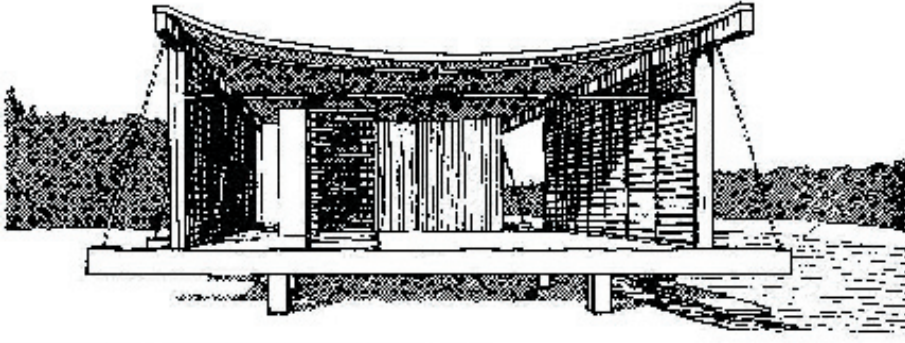


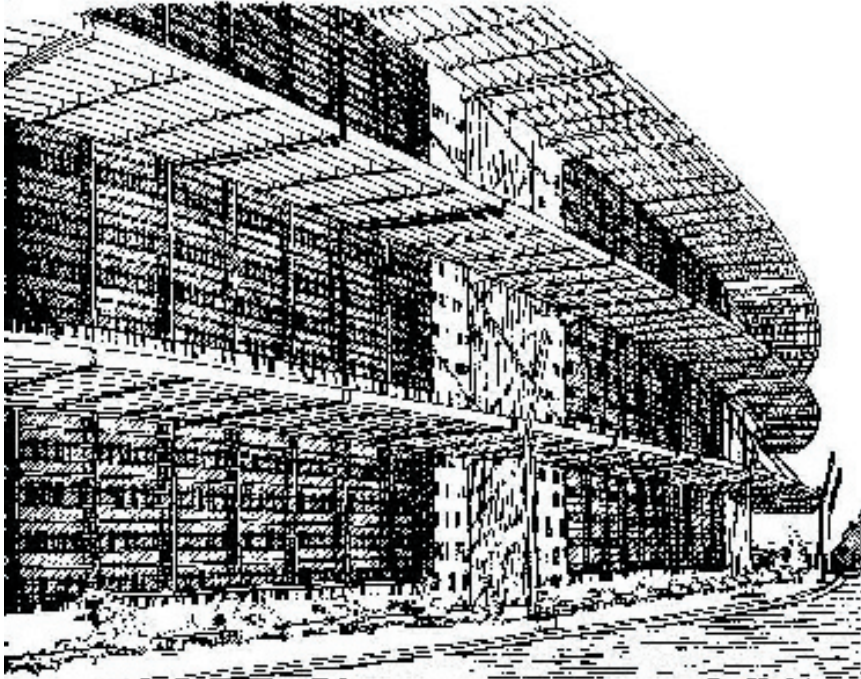
FIGURE [7, 8, & 9] Initial sketch ideas

# [Thesis Background]

## *Questions of a Natural Ventilation Design Determinate*



*Cacaoon House, Sarasota, Florida, Paul Rudolph*



*State of the Academy of the Antilles and Guiana, Fort-de-France, Martinique, Hans Haerle & Jérôme Nohel*

FIGURE [11 & 12] Ventilation ideas from Sun, Wind, & Light

[6] How does the site impact the overall planning of the project and how can I manipulate the site to further reinforce the possibilities of natural ventilation.

[7] This is a high traffic area, both pedestrian and vehicular, can I maintain the high pedestrian traffic but minimize the vehicular congestion and noise?

[8] Is there a need for the segregation of Public, Public/Private, and Private spaces, and if so, how can I achieve this?

[9] How will this hotel resort fit into the context of South Beach and what will determine the scale of each of the parts?

[10] What type of functions will occur here and how can they entice the public, especially the vacationers to the site? This questions has individual thoughts and wholistic ideas as well.



# [Thesis Background]

I am now at a point where I can state some of the positions I have taken along this thesis path. For the past few years as an undergraduate in architecture, we have been given a problem to solve, but this project was different. Here, I chose the problem and had to find the solution for myself. This solution wasn't a direct, clear thought that happened overnight, but instead was a series of investigations that were undertaken over months of time. Several of the initial scientific problems and investigations were approached and tested in another project I designed in the previous semester, but these guidelines carried over to this project.

I have always been an advocate of natural systems, especially when relying on natural ventilation to keep our home cool during the summer, and harvesting tree tops from woods that have been logged. Our only source of heat during the winter was our wood burner. So, I have gained a great respect for the fact that if mother nature is used properly, it can dramatically reduce energy costs and waste. During the dead heat of the summer, sometimes there is a need for fans to cool the skin if inside, but during the summer, that problem is mitigated by the fact that most of my time is spent outside. The same goes for in Miami, most of my time was spent outside. I was inside for sleeping, cooking, and the studio time, otherwise I was enjoying being naturally cooled by the breeze off the ocean.



FIGURE [13] Green wall. Source unknown

# [Physical Conditions]



FIGURE [14] Aerial site photograph. Source: [www.terraserver.com](http://www.terraserver.com)

My Thesis site is located between 21st and 22nd streets along Collins Avenue along Miami Beach and South Beach. Currently, the site is called Collins Park, where there is a large amount of vegetation and parking for public beach access. As you move from the parking lot, you move up toward the boardwalk and from there you can maneuver north and south along the boardwalk, or move to the east and enter the beach. To the north of the site, there are small shops and restaurants that dot the street, and directly behind that, there is a Holiday Inn hotel. To the west, there are several 2-3 story retail shops and beyond that move into residential neighborhoods and a large parking garage. To the south, there is a Days Inn hotel that fronts the street, so there is quite the mixture of uses along the site.



FIGURE [15 & 16] South Beach images. Source unknown.

When you move out from the specific site, locals know Collins Park as the merging point between North Miami Beach and South Beach. The beach is definitely more popular the further south you go from Collins Park, yet there is no defining point between the two parts of the beach. All along Collins Avenue, there are hotel resorts that front the beach for miles. All keep in the Art Deco style. Code requires that buildings must conform to the Art Deco color palette, provided by Miami Beach Authorities. Art Deco colors are all pastels and most uses are whites, pinks, oranges, and light blues.



# [Physical Conditions]

Being a tourist attraction, Miami Beach is loaded with shopping, everything from high-end furniture and clothing, to small keepsakes. Several of the hotels have integrated retail centers and bars. Nightlife is also one of the most important parts of Miami Beach. In the entire semester I lived in Miami, the nightlife never skipped a beat. The mixture of people was, and still is, incredible. Miami is the melting pot of the US. At any given time, there could be five or six different languages being spoken on the beach at the same time. It was great to see different cultures all joined together. This also throws a small loop into the design of a hotel resort for so many different ethnicities, but luxury and comfort are still important to all.

Many of these hybrid hotels, restaurants, bars have an integrated outdoor connection. This is absolutely the key to the success of south beach. Having these outdoor seating areas creates an interaction with the cafe or bar, the people being served there, and the pedestrian and vehicular traffic passing by.



FIGURE [17] Site photograph towards boardwalk

FIGURE [18 - 20 below] South Beach images. Source unknown



## [Social Context]



FIGURE [21] Beach play on sunny South Beach, FL

Socially, South Beach attracts waves of vacationers. Attracting people from all over the United States, Canada, Mexico, Europe, and all other parts of the world. Because Miami is in a sub-tropical climate, the weather stays fair all year round, yet the summers can get quite hot and sticky due to the humidity. The heat and humidity may be a problem, but what draws people to Miami is the sunshine and beach. When people get too hot on the beach, some cool, refreshing water is only a few yards away. From morning till late afternoon, you can see the beach flooded with people basking in the sun, but when the sun starts to go down, that's when the pedestrian flow along the streets begins to fill up.

During the week, it's mostly seasonal residents and vacationers that fill the beach and streets. On the weekends, all the locals come out to the beach and Sunday becomes family day out on the beach. Volleyball, tossing the football or playing frisbee, there is an abundance of activity that creates hustle and bustle on most people's day off.





# [Program Summary]

---

<b>1.0 Multi-Purpose Space</b>	<b>1700 sq. ft.</b>
1.1 Seating Area [100 chairs]	800 sq. ft.
1.2 Stage Area	200 sq. ft.
1.3 Stage Activity Prep Area	200 sq. ft.
1.4 Storage for Tables	200 sq. ft.
1.5 Projection Room	50 sq. ft.
1.6 Reception Area	250 sq. ft.
<b>2.0 Exhibit Space</b>	<b>1500 sq. ft.</b>
Will house art such as sculpture that is not disrupted by light and outdoor air, also near retail space	
<b>3.0 Cafe</b>	<b>1000 sq. ft.</b>
Table seating only: no counter	
3.1 Table seating for 40	750 sq. ft.
3.2 Kitchen	250 sq. ft.
<b>4.0 Toilets</b>	<b>350 sq. ft.</b>
4.1 Men's Toilet	150 sq. ft.
4.2 Women's Toilet	200 sq. ft.
<b>5.0 Drinking fountain, telephone and janitor's closet</b>	<b>50 sq. ft.</b>

<b>6.0 Reception desk</b>	<b>100 sq. ft.</b>
<b>7.0 Facility Administration Suites</b>	<b>750 sq. ft.</b>
7.1 General manager's office	180 sq. ft.
7.2 Food manager's office	120 sq. ft.
7.3 Conference room for 8	200 sq. ft.
7.4 Secretarial and General Office	200 sq. ft.
Two secretarial stations plus copying, fax, and storage areas	
7.5 Unisex Occupancy Toilet	50 sq. ft.
<b>8.0 Employee Areas</b>	<b>600 sq. ft.</b>
8.1 Employee locker rooms: 2 @	300 sq. ft.
150 sq. ft.	
8.2 Employee break room	300 sq. ft.
<b>9.0 Storage Areas</b>	<b>300 sq. ft.</b>
9.1 Exhibit Storage	150 sq. ft.
9.2 General Storage	150 sq. ft.
<b>10.0 Service Area</b>	<b>800 sq. ft.</b>
10.1 Receiving storage	400 sq. ft.
10.2 Garbage/Trash area	400 sq. ft.
10.3 Dock	100 sq. ft.

# [Program Summary]

---

<b>11.0 Weight/Workout Facility</b>	<b>2500 sq. ft.</b>	<b>II. Net Area</b>	<b>181,875 sq. ft.</b>
11.1 Materials storage	150 sq. ft.	<b>III. Grossage</b>	<b>50 % of net area 90,938 sq. ft.</b>
11.2 General storage	150 sq. ft.		
11.3 Drinking fountains	10 sq. ft.	Includes area for entry, atria, corridors, elevators, escalators, fire stairs, wall thickness' ect.	
11.4 Free weights, machine weights, cardio area	2190 sq. ft.		
<b>12.0 Lobby Space</b>	<b>450 sq. ft.</b>	<b>IV. Supplemental Mechanical Space</b>	<b>5 % of gross area 4,546 sq. ft.</b>
<b>13.0 [2] Meeting Rooms @ 150 sq. ft.</b>	<b>300 sq. ft.</b>	<b>V. Total Area</b>	<b>277,259 sq. ft.</b>
<b>14.0 Bar/Club</b>	<b>1250 sq. ft.</b>		
<b>15.0 [170] Guest Suites @ 925 sq. ft.</b>	<b>157,250 sq. ft.</b>		
<b>16.0 Pool House</b>	<b>575 sq. ft.</b>		
17.1 Men's rest room	50 sq. ft.		
17.2 Women's rest room	75 sq. ft.		
17.3 Linen storage	200 sq. ft.		
17.4 Bar	100 sq. ft.		
17.5 Cafe/Outdoor snack stand	150 sq. ft.		
<b>17.0 Maintenance Storage</b>	<b>400 sq. ft.</b>		
<b>18.0 [40] Retail Shops @ 300 sq. ft.</b>	<b>12,000 sq. ft.</b>		

# [Linear Design Objectives]

## [Culture] Miami Beach, FL...why?

- People are there for the beach
- Relaxation, Rest, Enjoyment
- People like to be served

## [Context]

- Upscale island community
- Great Place for innovation
- "Melting Pot" of the US.

## [Site]

- Direct Beach Access
- Merging point between South Beach and North Miami Beach
- Heart of boardwalk usage
- Views of nature
- Micro and macro climate make ideal conditions

## [Building]

- Single Loaded for maximum ventilation
- Public beach, private/public ground
- Hierarchy of public to private
- Multi-Use

## [Space]

- Building materials in context
- Dynamic Space usage
- Structure has versatility
- Facades do more than enclose
- User has control

## [Place]

- Location is "Eye Candy"
- Resort gives back to earth
  - Less energy consumption
  - Learning tool
- Leaves lasting impression on user

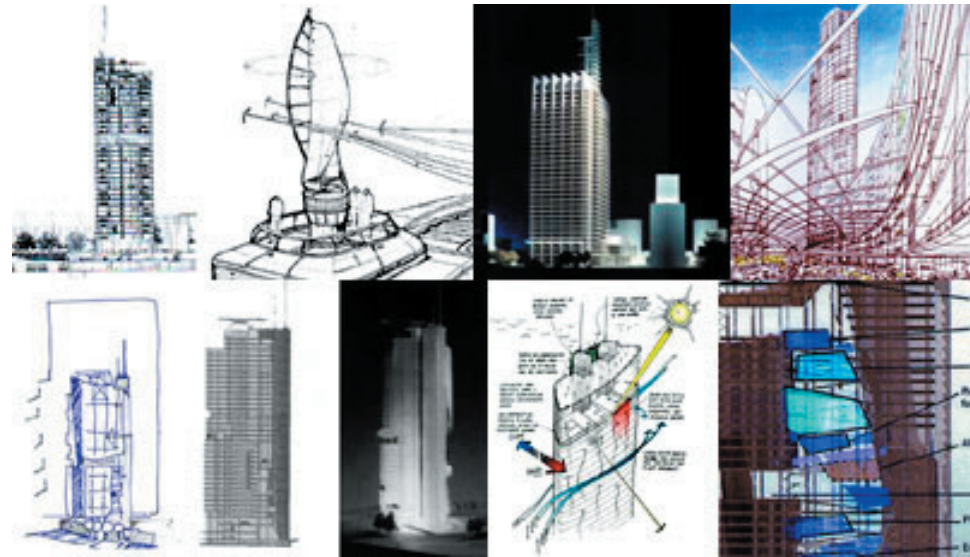


FIGURE [22] Sustainable Tower - concept studies

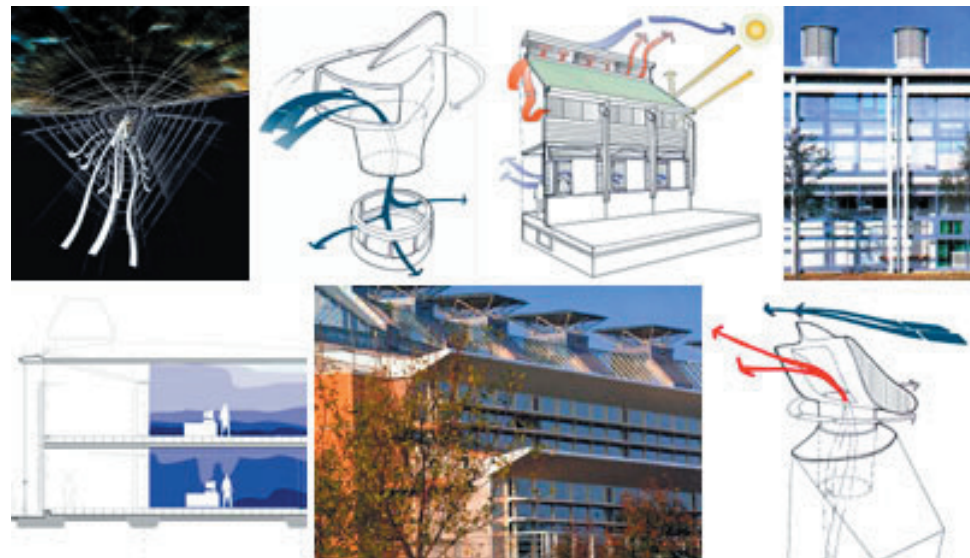


FIGURE [23] Wind Tower - concept studies

# [Ventilation Design Objectives]

Natural Ventilation throughout entire site, maximize Micro and Macro wind patterns, ability to cool day and night, retention of park, relationship but separation of public and private spaces, maximize energy efficiency through building envelope, use of dynamic skins to give user most control, equality of living units through tested repetitive design, defense of intense heat through deepened overhangs

## [Natural Ventilation]

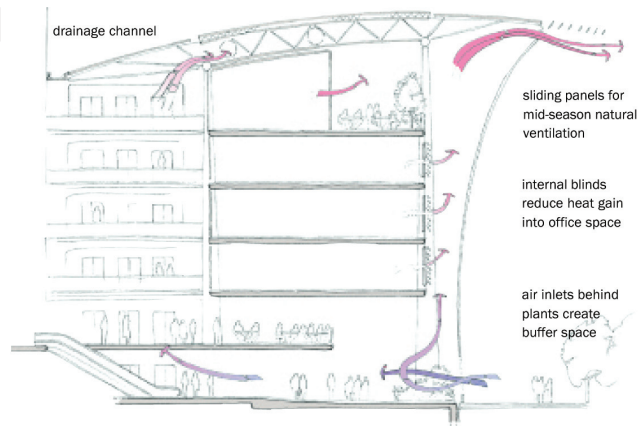
-performed series of Fluid Mapping Table [FMT] tests

-Test diagrammatically the flow of wind through multiple room configurations

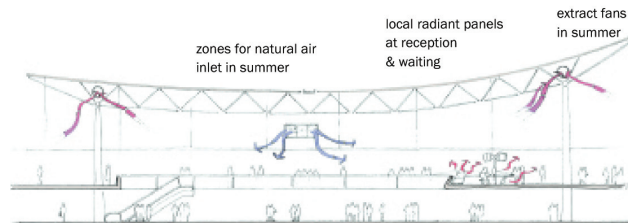
-Based tests on micro and macro climates throughout all times of year

-Plan and section analysis used to determine inlet and sizes

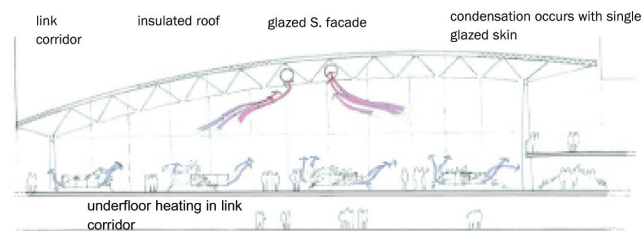
-Used series of living units to demonstrate wind control



Zone 1 - Shopping Mall ventilation strategy



Zone 2 - Conference Centre Foyer ventilation strategy



Zone 3 - Link Corridor ventilation strategy

FIGURE [24] WTC Amsterdam - concept studies

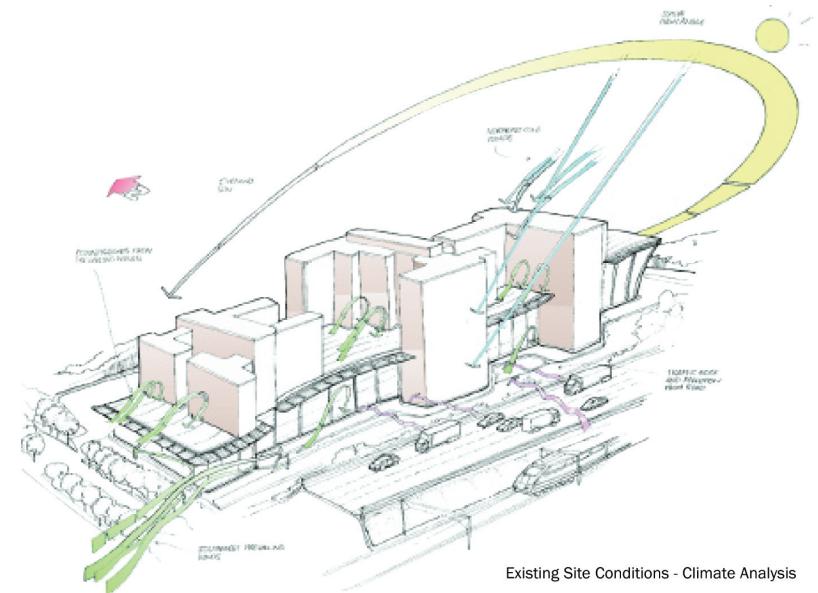


FIGURE [25] WTC Amsterdam - concept studies

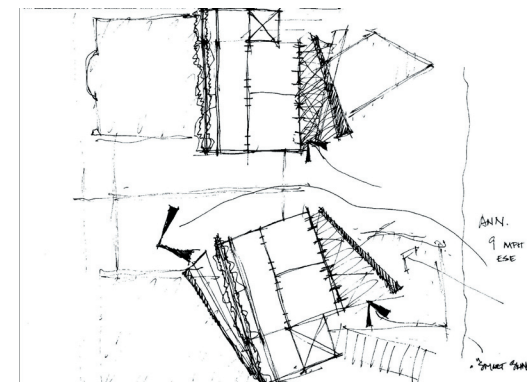


FIGURE [26] Conceptual sketch studies

This schematic sketch begins to harness the micro climate along with the idea of a single-loaded corridor, skins, and sky-bridges. This was just a small portion of the tower and how the individual rooms could work as a whole.



# [Living Units Design Objectives]



FIGURE [27] Schematic room design

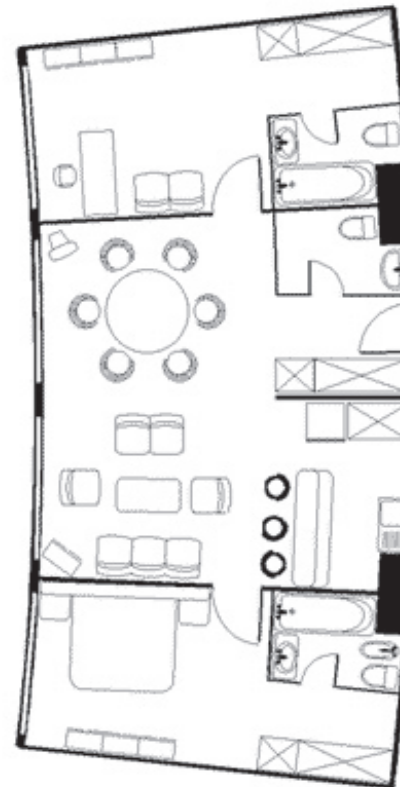
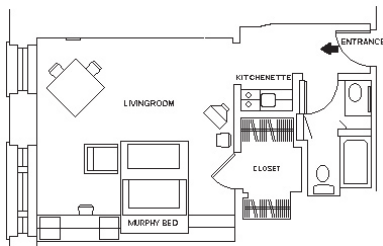
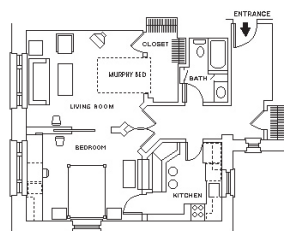


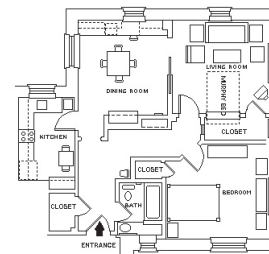
FIGURE [28] Schematic suite design



**STANDARD ROOM - 380 SQ. FT.**  
UNITS: 300, 400, 500, 600



**SUPERIOR SUITE - 690 SQ. FT.**  
UNITS: 301, 401, 501, 601



**PREMIER SUITE - 980 SQ. FT.**  
UNITS: 208, 308, 408, 508, 608

FIGURE [28, 29, &30] Typical hotel room layout

## [Living Units]

- Entry through most public to most private
- Layered Skin, block sun open views, allow vent.
- East wall for views and permeability
- West wall for service
- N & S walls for structure
  - Privacy, direct winds
- Equal apartments allow every one the advantage
- Balconies acts as shading device, directs wind, provides a outdoor relationship
  - house PV cells



# [Residential Tower Design Objectives]

## [Residential Towers]

- Saw tooth
- Privacy
- Wind Control
- Accessibility

- Grouped for vertical access and max wind

- "sky bridge" connection
- Allow flow of wind east and west

- App. 30' of open space below towers allow wind to pass to lower buildings

- Vertical access centrally located and at opposite ends

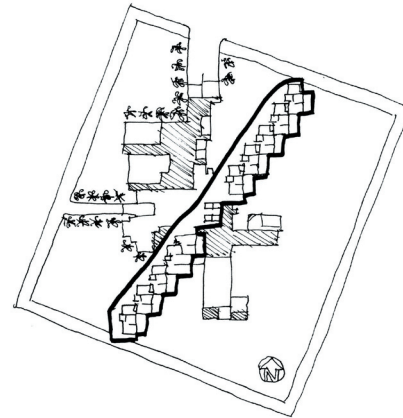


FIGURE [31, 32] Conceptual site planning

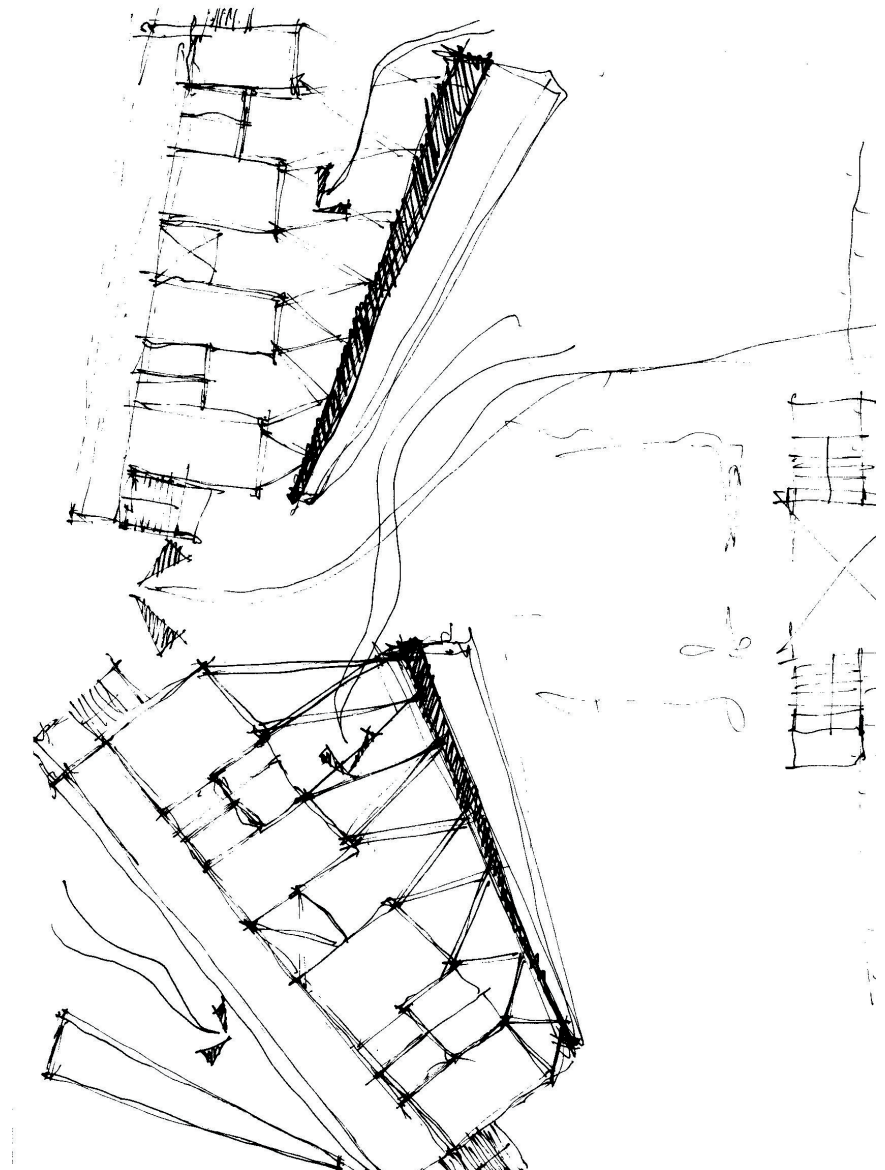
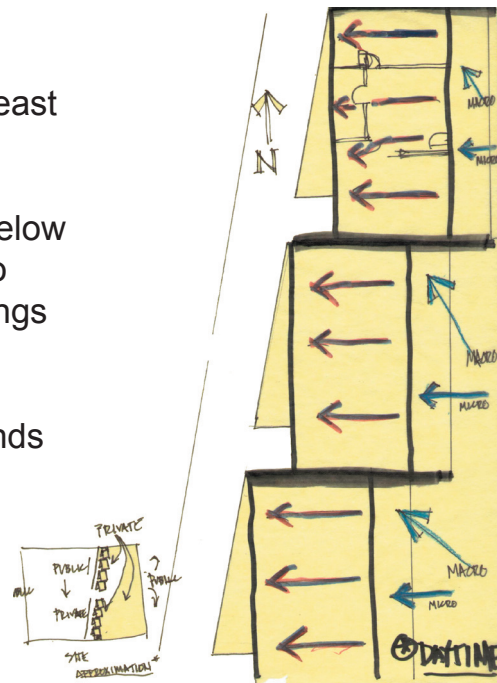


FIGURE [33] Conceptual tower planning and design



# [Site Design Objectives]



## [Site]

- Retain Park usage
  - series of pavilions
- Create site divisions
  - Public
  - Private
  - Public/Private
- Site lines/Axis
  - Entry
  - Lobby
  - Circulation
  - Boardwalk
  - Beach
- Harness Ventilation but allow continued flow

FIGURE [34] Conceptual site planning



# [Concept Site Studies]

[1] Rooftop park and activities

[2] Site division by tower, but continue movement of wind below the tower

[3] Amphitheater-like site gradation

[4] Wind-induced pedestrian path from beach to shopping courtyard.

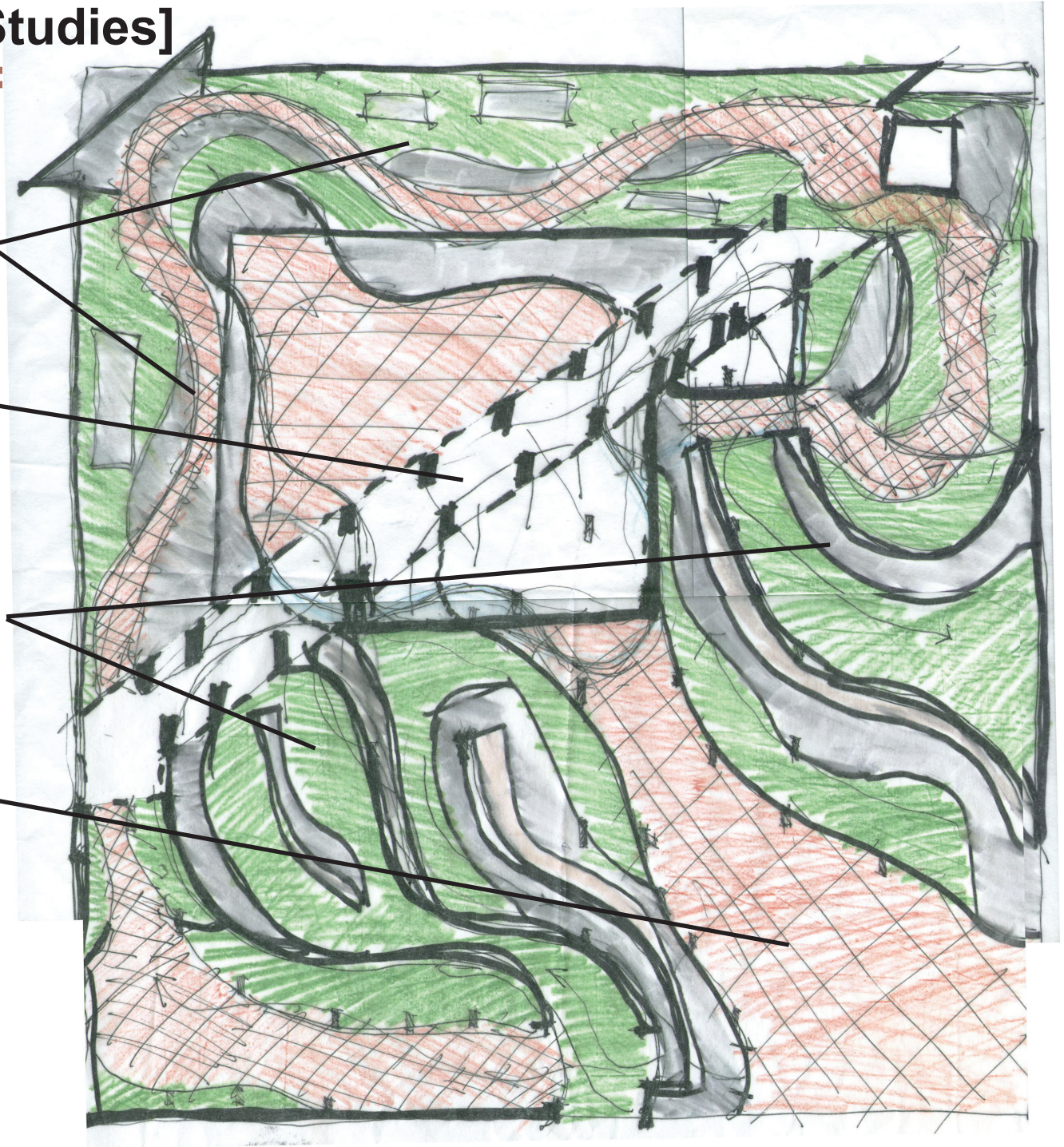


FIGURE [35] Conceptual site planning



# [Research Process]

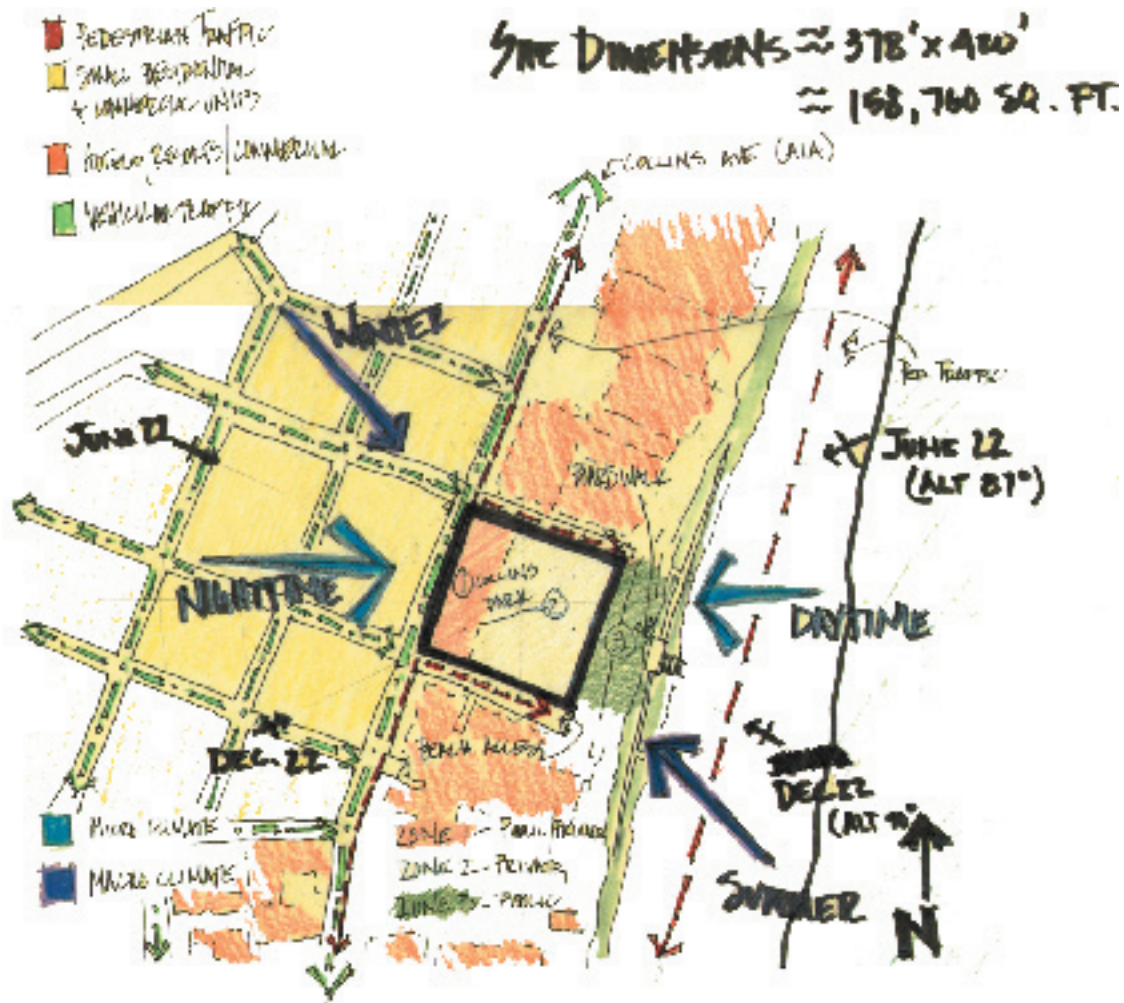


FIGURE [36] Conceptual master plan

## I. Site analysis

Since I was a resident in Miami, I have a good understanding of the site conditions that existed at Collins Park. Culturally and contextually, I had things down, but there was a whole other side of the research I had to do, the scientific aspect. The use of wind rose and climatic data started my understanding of how the site worked as a micro and macro climate. The set of wind roses for the year were taken at the Miami International Airport about 15 miles off the coast. This helped determine the macro climate and this became the subservient addition to the micro climate. Most of the design process came from the basis of convection currents that pull air off the ocean toward the inland during the day when the land heats up faster than the water. The opposite happens then the land cools faster than the ocean and the air is pulled from inland out. This created a defining edge to how the building would be oriented. It also defined the corridor system, which meant that the building system had to be a single loaded corridor to allow both day and night ventilation.

# [Research Process]

## II. Natural Ventilation Design Techniques

Using this knowledge, I began testing different room orientations. I chose to start at the room scale because I felt that it was the most important part to the resort. Smaller scale to larger definitely worked toward my advantage in designing a naturally ventilated resort. I took sever examples from Sun, Wind, and Light and tested against their diagrams and how the dynamic flows of the fluid mapping table matched up with theirs. I also wanted to see the turbulence created by the wind flow and the pockets of stagnate air they created.

CLIMATE / BUILDING TYPE			SUN + WIND			SUN + LEE			SHADE + WIND			SHADE + LEE		
Internal-Loaded Building	Skin-Loaded Building	Outdoor Rooms	W	F/S	Su	W	F/S	Su	W	F/S	Su	W	F/S	Su
Cold	Cold	Cold	4	4	4	5	5	5	1	1	1	2	2	2
		Cool	4	4	4	5	5	1	1	1	5	2	2	2
	Cool	Temperate	4	6	4	5	5	1	1	3	5	2	2	2
		Hot-Arid	4	2	4	5	3	1	1	3	5	2	4	2
Cool-Arid	Temperate-Arid	Hot-Humid	4	4	4	5	1	1	1	5	5	2	2	2
Cool-Humid	Temperate-Humid	Hot-Humid	4	4	4	5	1	1	1	5	5	2	2	2
Temperate-Arid	Hot-Arid & Hotter	Tropical-Arid	2	2	2	3	3	3	3	3	3	4	4	4
Temperate-Humid & Hotter	Hot-Humid & Hotter	Tropical-Humid	4	4	4	1	1	1	5	5	5	2	2	2

Scales:  
 1 = worst microclimate  
 5 = best microclimate  
 values = sum of climatic element values from Table A

TABLE B. Values of Microclimatic Conditions Combinations by Climate and Season

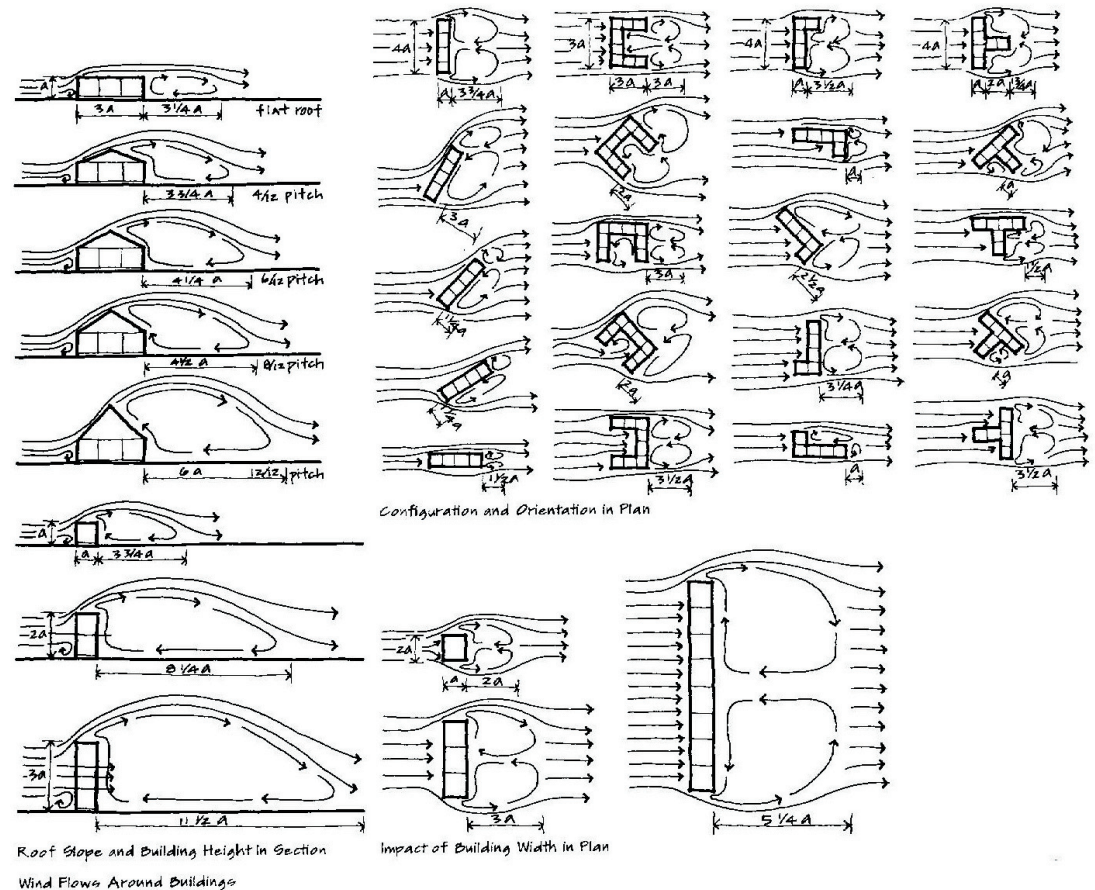
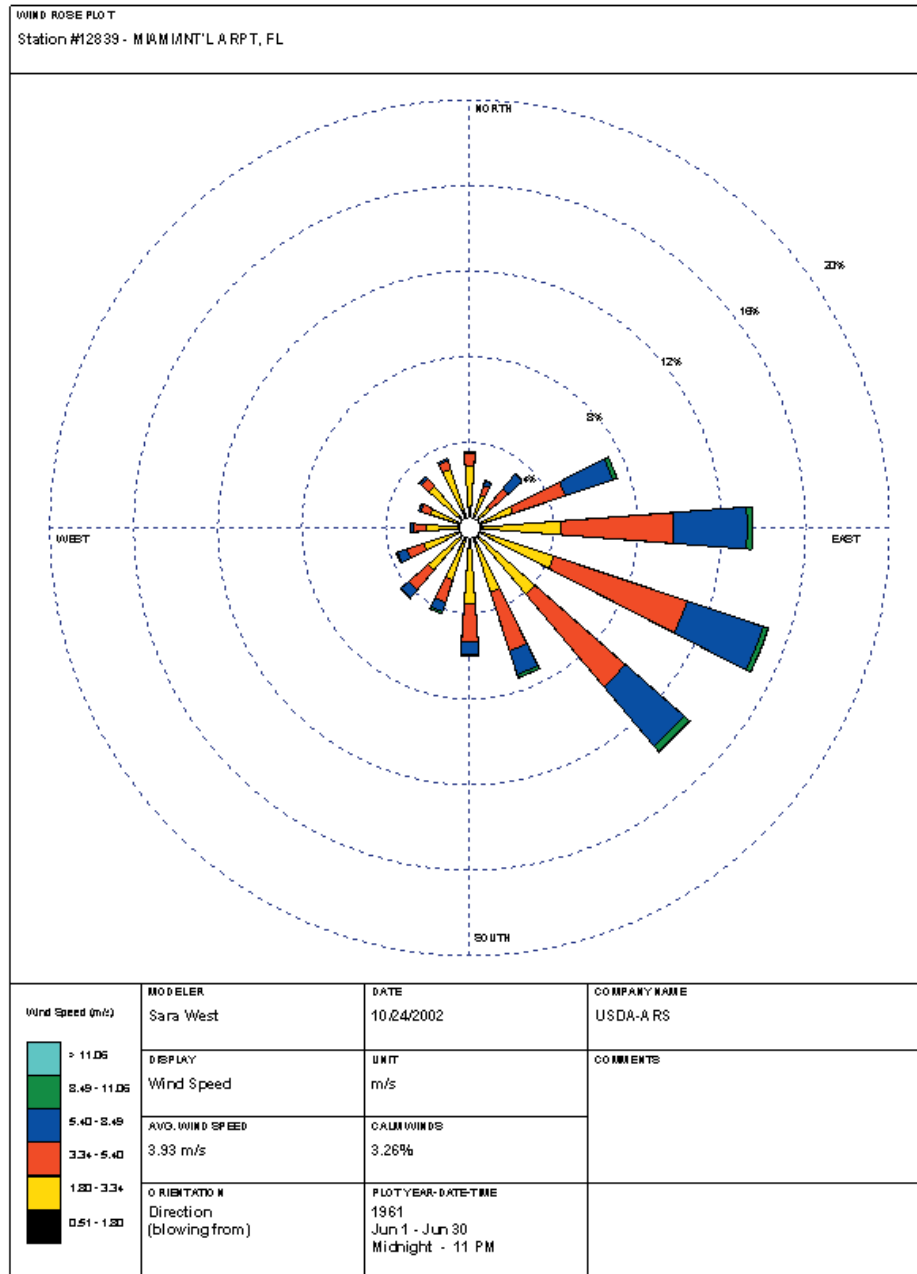


FIGURE [37 & 38] Ventilation guides - Sun, Wind & Light

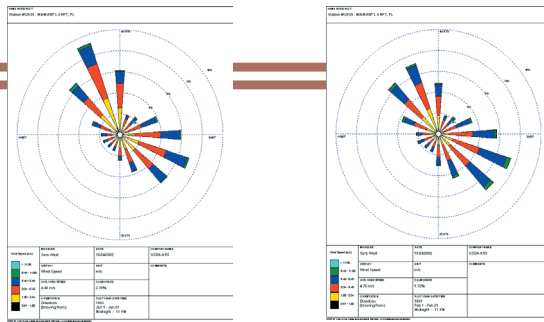
# [Research Process]



After testing the different variables that came with building orientations, protrusion walls, and different opening sizes and heights, I could move into a wholistic room design. The Fluid Mapping Table (FMT) results did not alone determine how the rooms would be configured. I felt there was a progression of spaces from the most public [Foyer] to the [Living Area] then to the central [Dining/Restroom] then to the most private [Bedroom]. I also located the service spaces along the corridor to open the East facade up to the ocean as much as possible. Once the major spaces were located in diagrammatic form, I went back to the Fluid Mapping Table and put together a series of physical models of clear Plexiglas so that the effects of the wind were easily defined. I tested several configurations in several directions. The great thing about the FMT was that I can test and wind direction I want in both [Plan] and [Section]. By digitally photographing and video recording this process, I was able to examine how each model worked in all their different orientations. I could then modify the room models to their most effective plan and work in section so that I could size the windows and determine the proper heights of each of them as well. One major rule of thumb is that the inlet openings are equal to, or smaller than the outlet openings to maximize velocity of the incoming air. If the outlet is too small, wind won't flow through the space as designed. The design of window placement also evolves around the location of the user. A window can't be places in a location that the air won't move over the occupant otherwise the use of Natural Ventilation won't work.

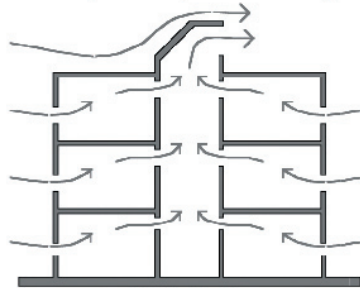
FIGURE [39] June windrose





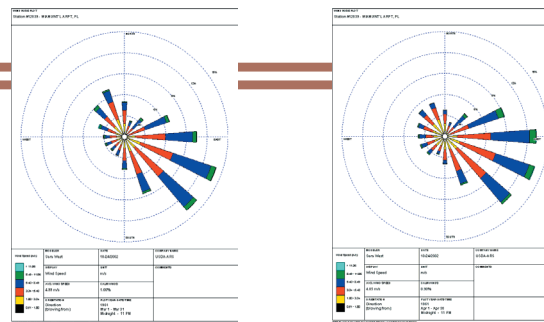
### [Buoyancy-Driven Stack Ventilation]

"Buoyancy-driven stack ventilation relies on density differences to draw cool, outdoor air in at low ventilation openings and exhaust warm, indoor air at higher ventilation openings. The illustration below shows a schematic of stack ventilation for a multi-room building. A chimney or atrium is frequently used to generate sufficient buoyancy forces to achieve the needed flow. However, even the smallest wind will induce pressure distributions on the building envelope that will also act to drive airflow. Indeed, wind effects may well be more important than buoyancy effects in stack ventilation schemes, thus the successful design will seek ways to make full advantage of both."



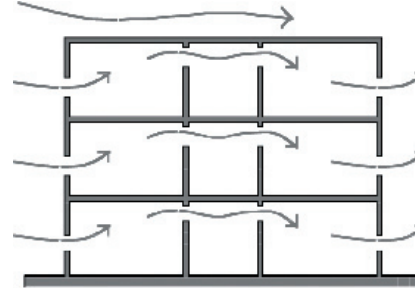
Global Stack Ventilation

FIGURE [52, 53, & 54] Ventilation guidelines - Nat Vent

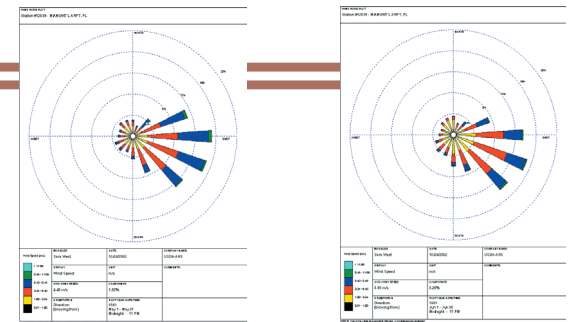


### [Wind-Drive Cross Ventilation]

"Wind-driven cross ventilation occurs via ventilation openings on opposite sides of an enclosed space. The illustration below shows a schematic of cross ventilation serving a multi-room building, referred to here as global cross ventilation. The building floor plan depth in the direction of the ventilation flow must be limited to effectively remove heat and pollutants from the space by typical driving forces. A significant difference in wind pressure between the inlet and outlet openings and a minimal internal resistance to flow are needed to ensure sufficient ventilation flow. The ventilation openings are typically windows."

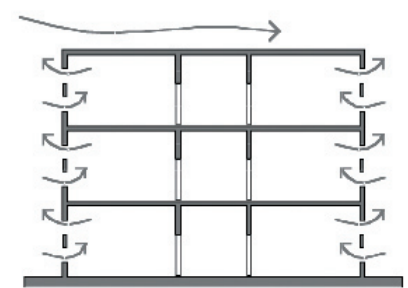


Global Cross Ventilation



### [Single-Sided Ventilation]

"Single-sided ventilation typically serves single rooms and thus provides a local ventilation solution. The illustration below shows a schematic of single-sided ventilation in a multi-room building. Ventilation airflow in this case is driven by room-scale buoyancy effects, small differences in envelope wind pressures, and/or turbulence. Consequently, driving forces for single-sided ventilation tend to be relatively small and highly variable. Compared to the other alternatives, single-sided ventilation offers the least attractive natural ventilation solution but, nevertheless, a solution that can served individual offices."



Local Single-Sided Ventilation

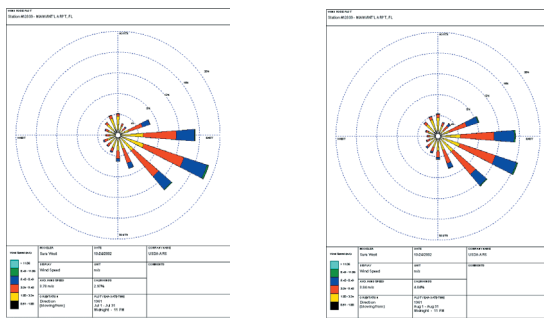
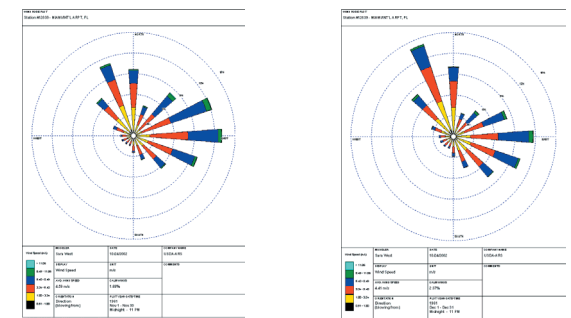
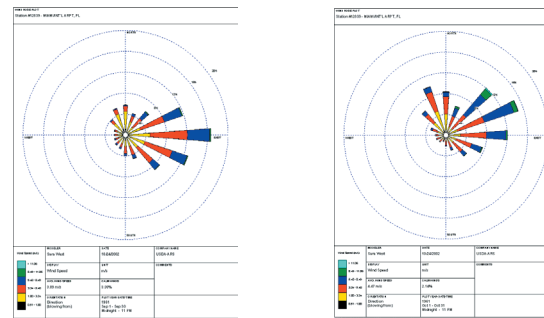
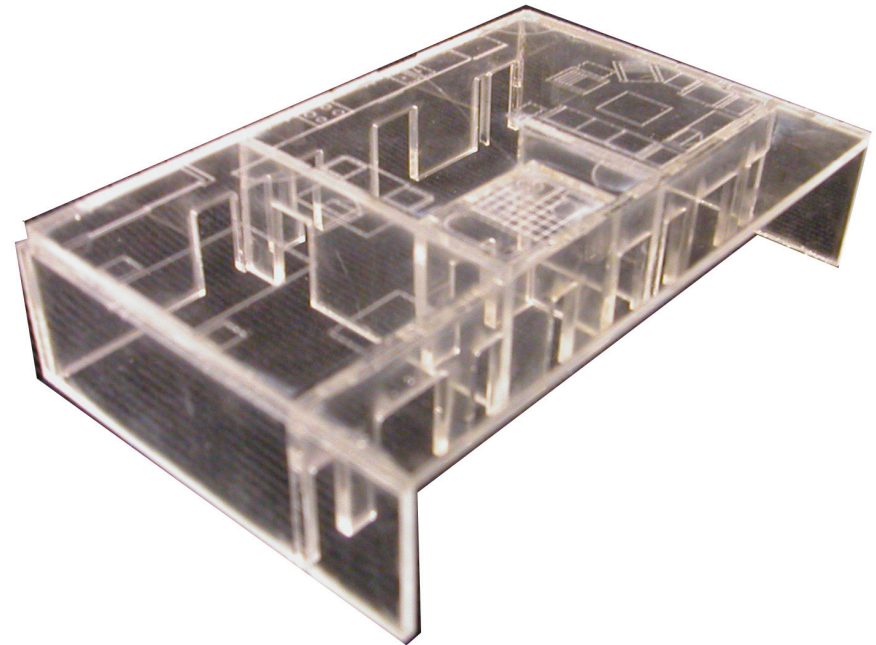
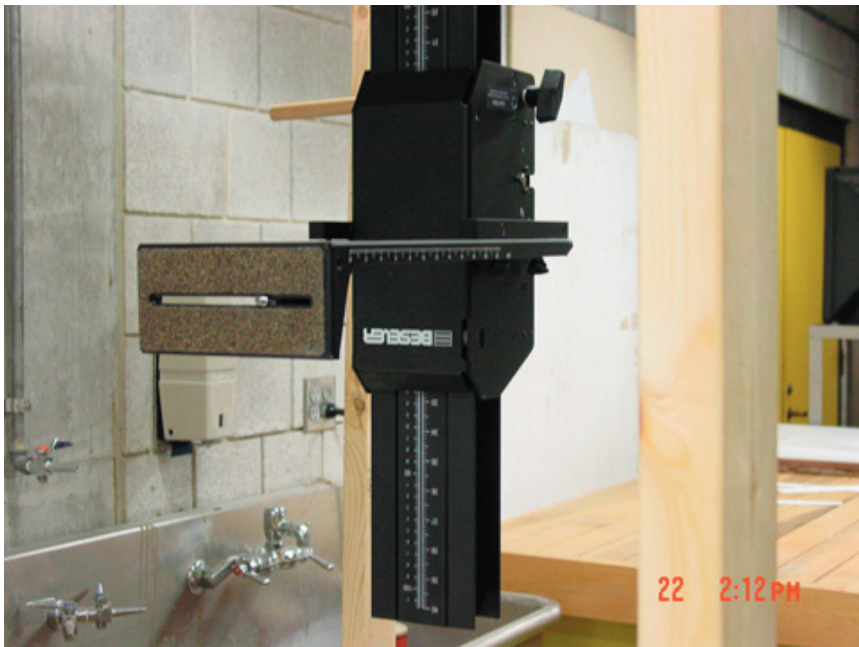
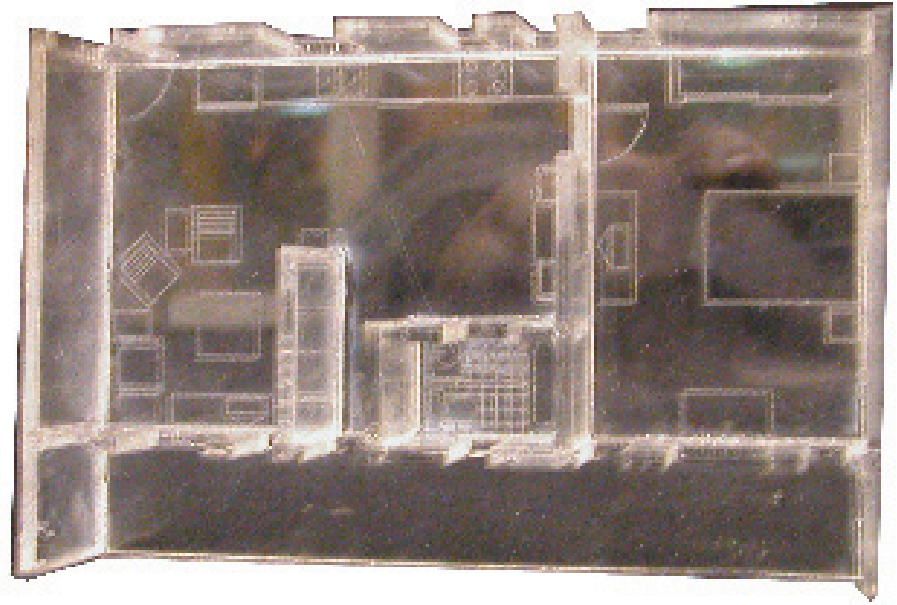


FIGURE [40 - 51] Yearly windrose



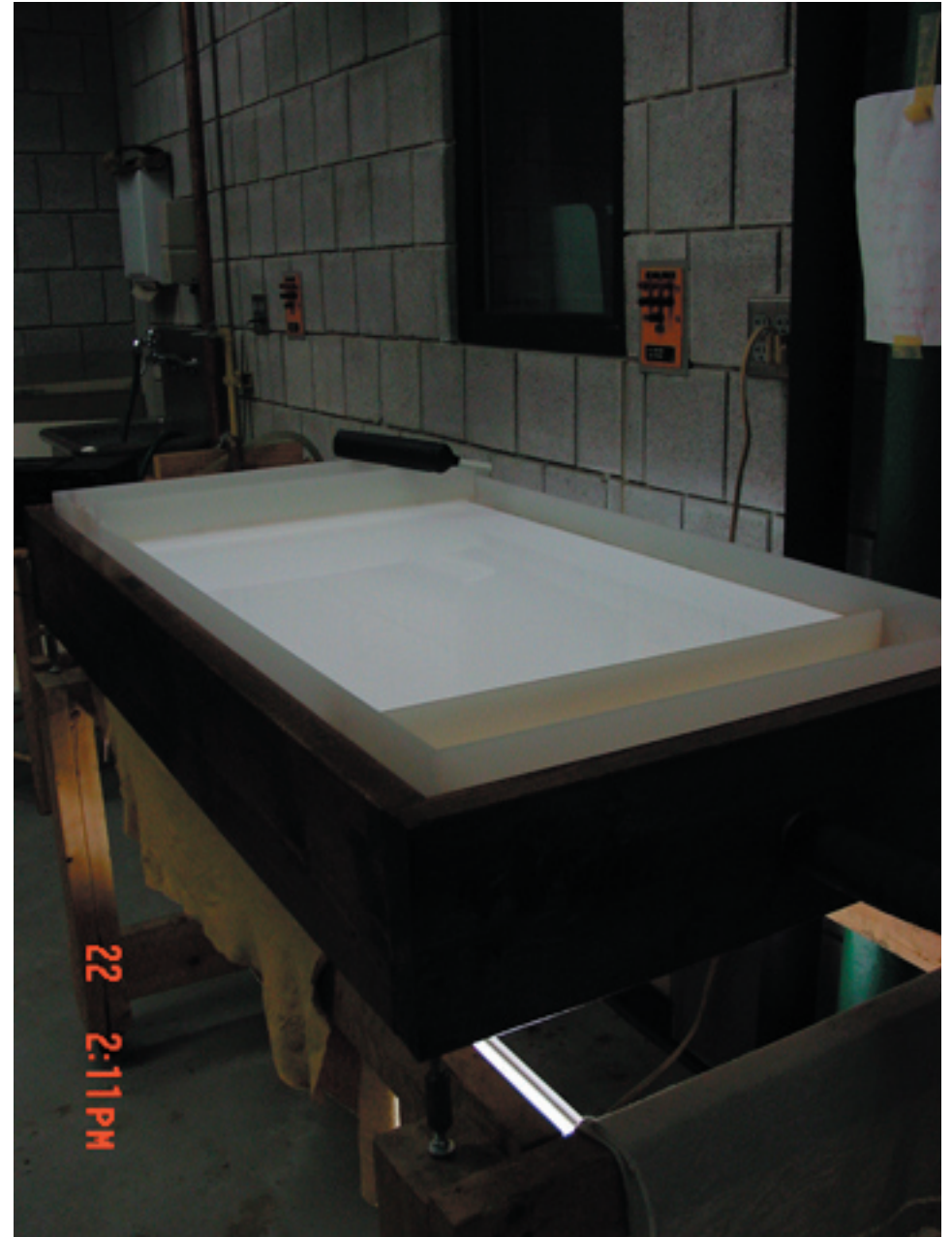
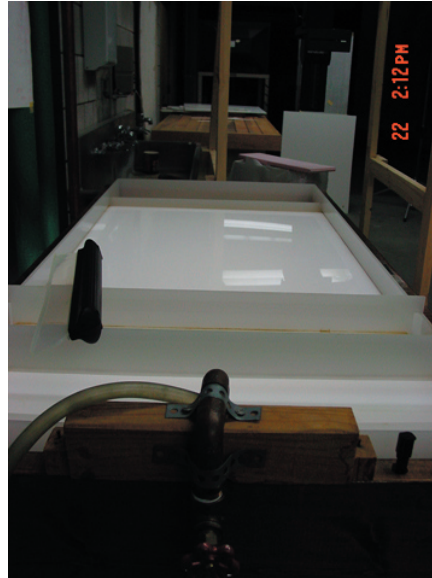
# [Fluid Mapping Table]





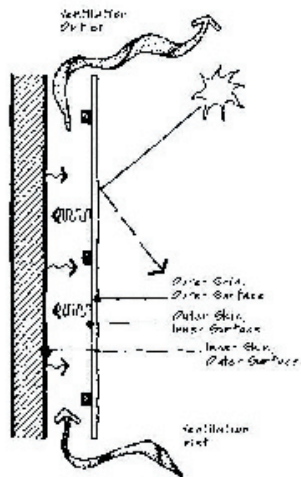
# [Fluid Mapping Table]

The fluid mapping table (FMT) uses a pool of water that is pumped in by a hose from a faucet. The water then fills up a small tank on one end of the table and then flows out over the large flat surface of the table. The two images on opposite page are a study model I created using the laser cutter and pluxy. The walls are about 1" in height and the openings are tall enough to let water flow through them. So, you place this study model on the flat table and let water run through it. The user controls the speed of the water as to control wind speed. Once the model is in place, they is a ink dye solution that you place into the water and that mimics the wind flow patterns and how they flow into the building. I building a camera mounting station to allow streaming video to be taken of this process. The camera jig slides over the table and can be adjusted to the correct height and location desired. For this project, I did a whole series of tests with single and multiple units with different wind directions and speed. Plans can be manipulated and changed into sections to see how wind flows into the building in a different dimension.



# [Skins Research]

Tested Double-Skin Constructions



Diagrammatic Section of Double-Skin Wall

FIGURE [55] Skins section - Sun, Wind & Light

The human skin is a multi-layered stratum that performs many tasks such as keeping heat in, letting heat escape, blocking the sun, and many other tasks. The object of building skins are to manipulate or defend against the outside environment in unwanted situations. In the case of Miami, a sub-tropical location, it is an absolute must to keep the direct sun out of the buildings, but let in the abundant breeze that flows inshore and offshore. The skins are a series of building materials that produce a permeable service to allow the wind in, but shade the interior as not to all internal heat gains from the sun. They can also be used to guide views, direct reflections, and force wind into necessary spaces and places. They can also be used to create different interior atmospheres by simply changing fenestration coverings or lighting aspects. Large exterior building skins can create cavities or openings where mass amounts of ventilation may enter the building without all of the heat from the sun.

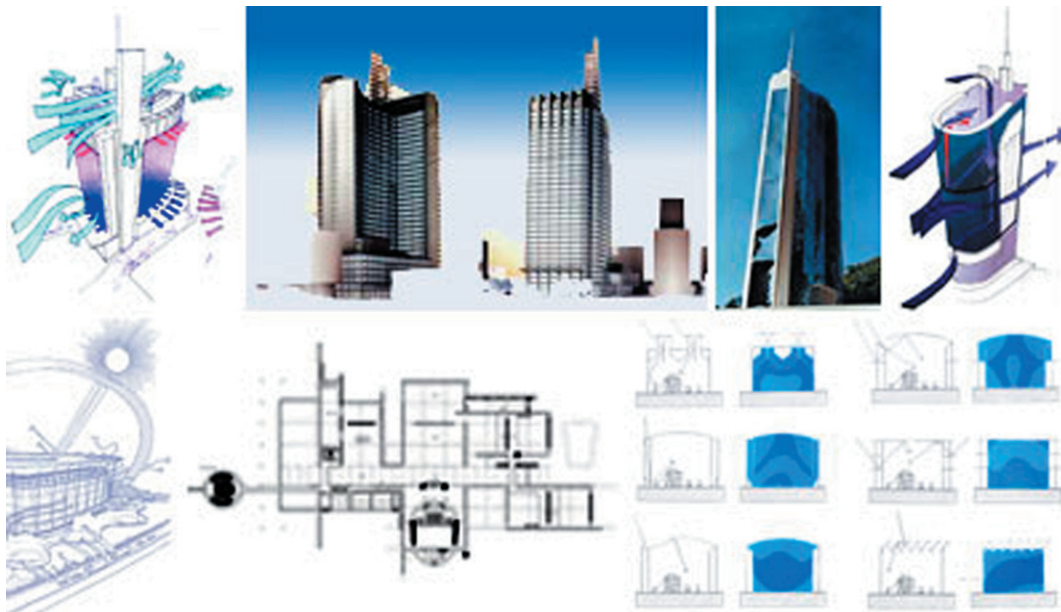


FIGURE [55] Building Skins - Unknown author

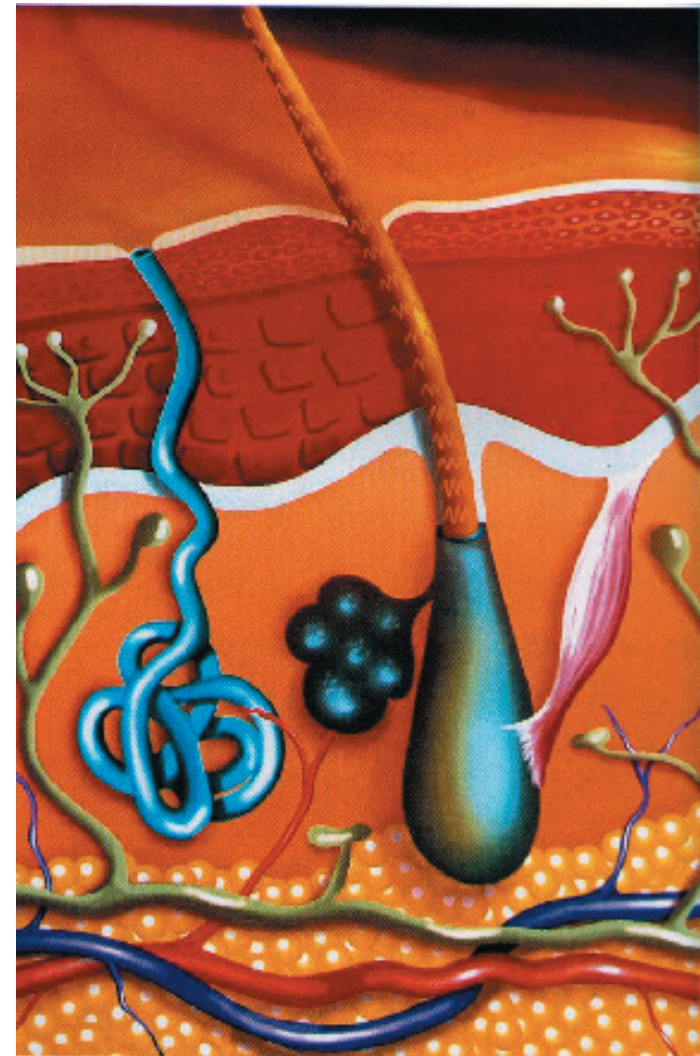


FIGURE [56] Human Skin - Intelligent Skins



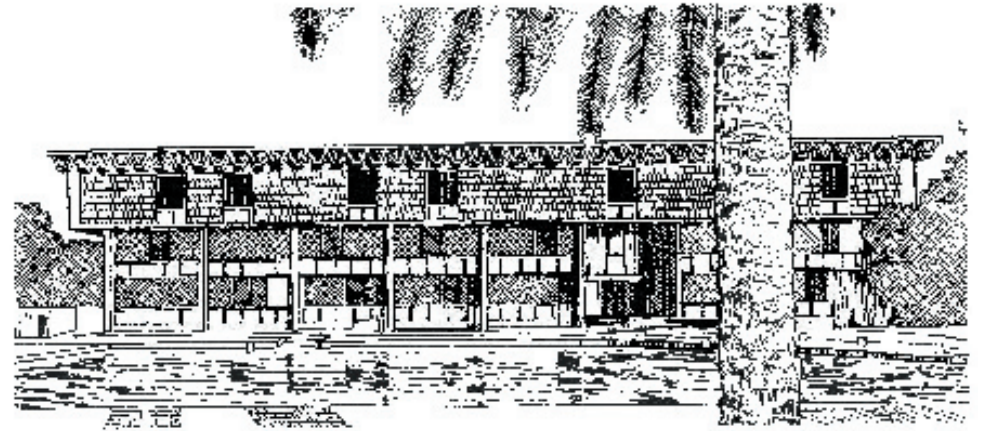
# [Skins Research]

The skins of this resort work two-fold: one, on the east side of the building, they are more internally bases to allow the most user control over their comfort levels, while the west side will house a green wall that shades the sky-bridges that connect circulation to the living units. The green wall protects the bridges from the hot afternoon/evening sun as to keep the residents comfortable at all times of the day.

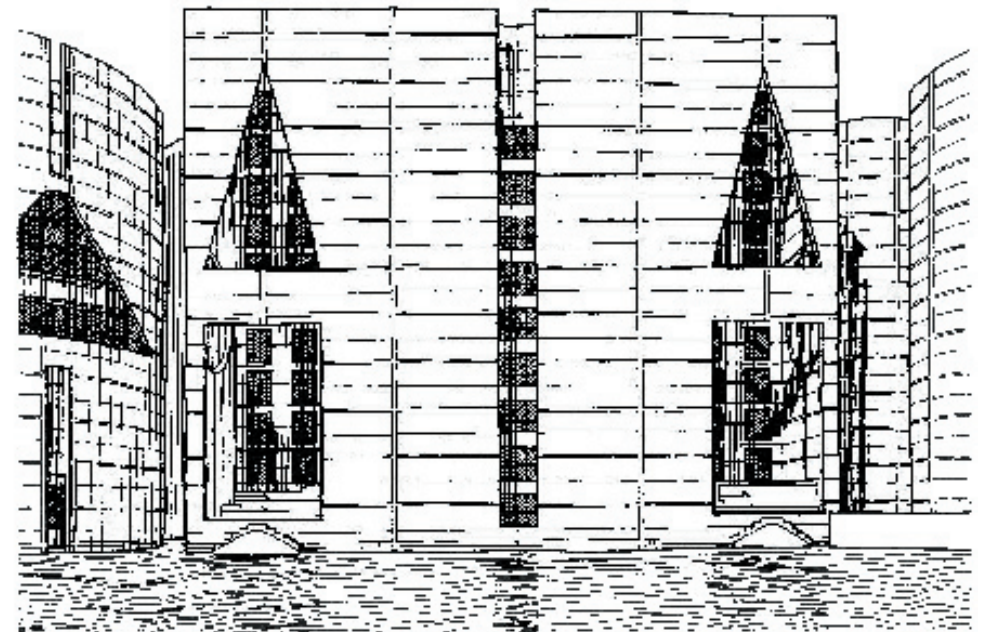


FIGURE [57, 58, 59] Wall Skins - Intelligent Skins

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J.S. Embassy to Iraq, Baghdad, José Luis Gert

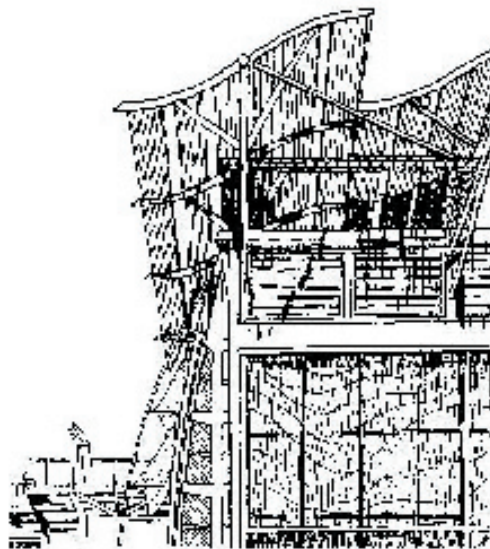


Office Block, National Assembly Building Dhaka, Bangladesh, Louis I. Kahn

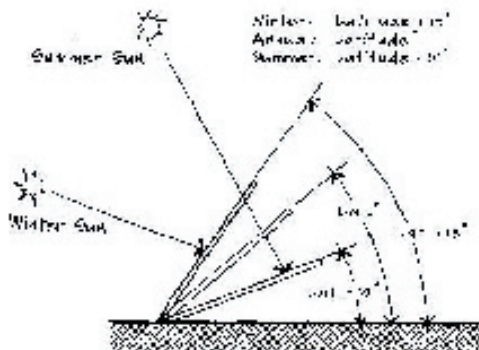
FIGURE [60 & 61] Building Skins - Sun, Wind, & Light

# [Photovoltaics]

The introduction of Photovoltaic Cells (PV) has impacted the design process in this resort. Miami receives a multitude of sunlight throughout the year and with large building faces covered in PV panels, substantial energy production are apparent. BP is a leader in the PV industry by utilizing their gas pump shelter roofs to house PV and collect the sun's energy and make good use of it. The goal of PV in this resort was to operate the Building Management System (BMS) when needed, or to sell back to the grid when in excess.



UK Pavilion, Expo '92, Seville, Spain,  
Nicolas Grimshaw & Partners



Recommended PV Tilts

FIGURE [62 & 63] PV design - Sun, Wind, & Light

## solar economics



### Solar Savings Estimator

You can fine tune your system size using the +/- buttons below, and then click on "Recalculate" to see the adjusted cost and savings.

+↑ 6 kW ↓-

Recalculate

**System Size:** Medium

#### What it costs:

Retail Price:	\$51,000
Rebates:	\$0
Tax Credits:	\$0
<b>Final System Cost:</b>	<b>\$51,000</b>

#### What you save:

	Monthly	Annually
Electricity Production:	656 kWh	7,873 kWh
Bill Savings:	\$56	\$668
Tax Savings:	\$79	\$952
Bill Reduced By:	22%	22%

### your report

#### Geographic Details:

City: Hialeah  
State: FL

#### Sunlight Intensity:

The sunlight intensity in your area is rated **Very Good**



#### Environmental Benefit:

Per year, this system will eliminate the production of

17,439 lbs of CO<sub>2</sub>  
37.9 lbs of NO<sub>x</sub>  
69.4 lbs of SO<sub>4</sub>

This is equivalent to planting 3 acres of trees



FIGURE [64] PV economics chart - www.bp.com





# [Results - Final Design]

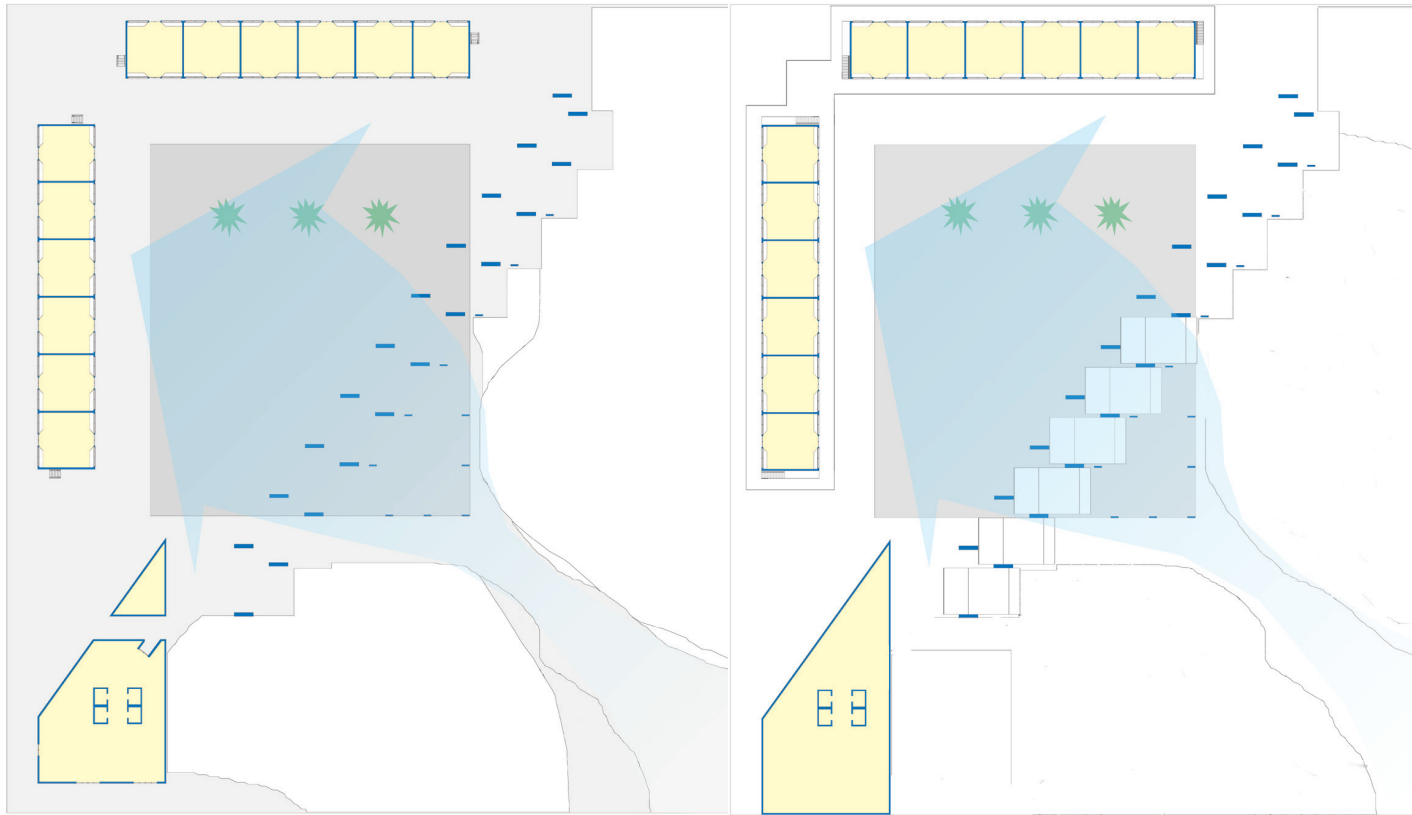


FIGURE [68 & 69] Ground plan and 2nd story plan

FIGURE [70] Heliodon study model

The planning of the site evolved around the tower itself first. Harnessing the daily wind currents was first and foremost. As the micro-climatic wind flows from east to west off the ocean during the day, the rooms are organized to accept the maximum amount of wind. The saw-tooth form of the tower then creates a system that captures and directs the macro wind flow as seen in the windrose charts. The lower three levels of the building are open to the breeze to allow the retail center to the west the natural breeze as well. This also creates a division between the public and private spaces. The structure of the building then creates a rhythm within the building and the spaces below. To create a pedestrian friendly atmosphere, there are wind deflection wings that reduce scale and have maneuverability to direct more wind flow when necessary.



[Heliodon study model] courtyard



# [Plans]

The lobby and drop-off valet area fronts Collins Ave. and 21st St. The valet parking area is sheltered by a cantilevered office space above it. The main circulation tower is centrally located within the service spaces. Fronting the street, the retail spaces have shops on both sides of the street and courtyard. The multi-level shops create a diversity along the street. The rooftop replaces any of the park that I have taken away for the building. Rooftop shops, cafes, sitting spaces and nodal points create a completely new atmosphere to South Beach. This rooftop then merges with the amphitheater like groundscape. There is a progression from the initial ground level up to the rooftop with a main circulation path from the beach to the courtyard and shopping.

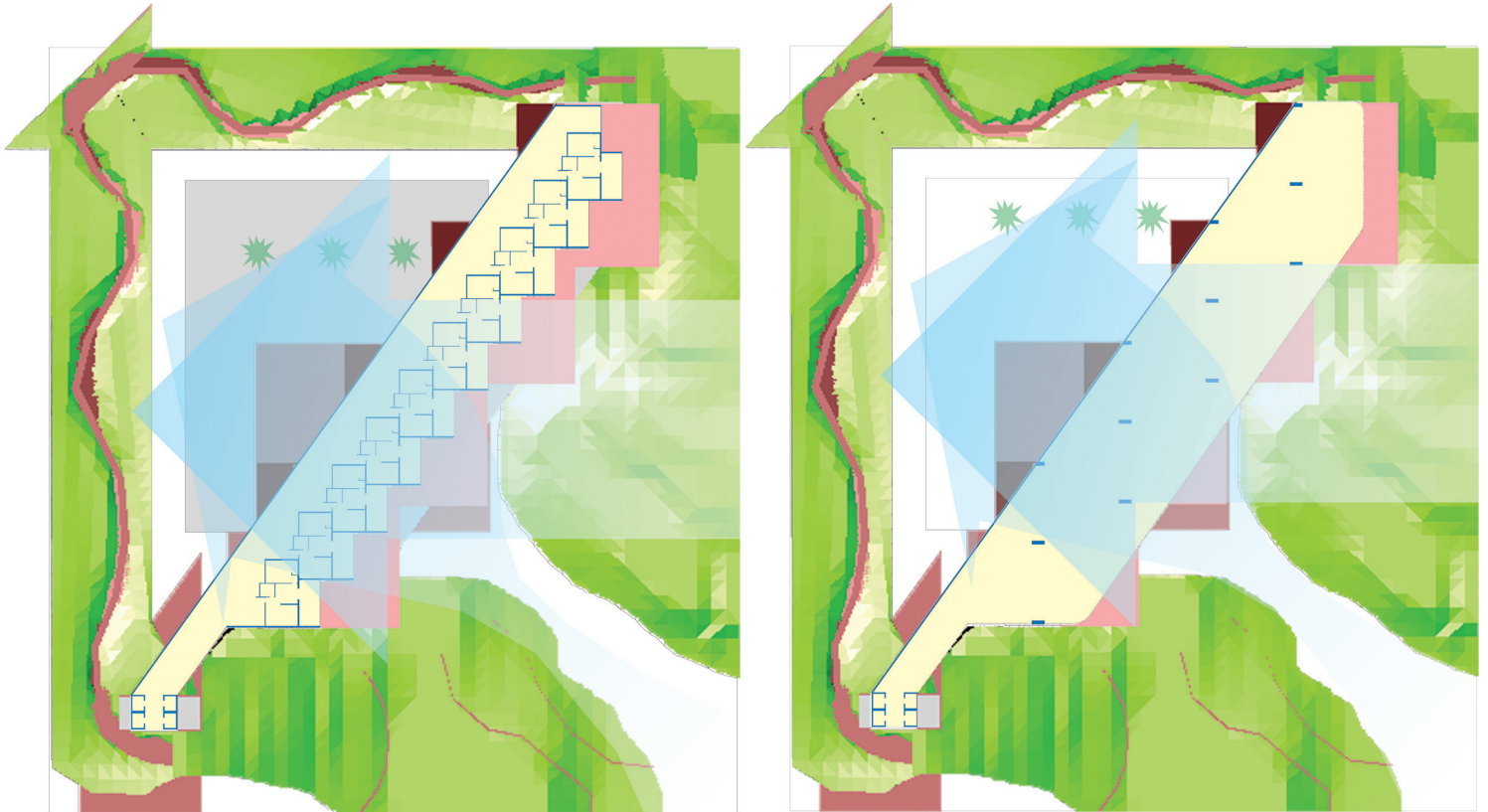


FIGURE [71 & 72] Tower plan & roof plan

FIGURE [73] Heliodon study model



# [Elevations]

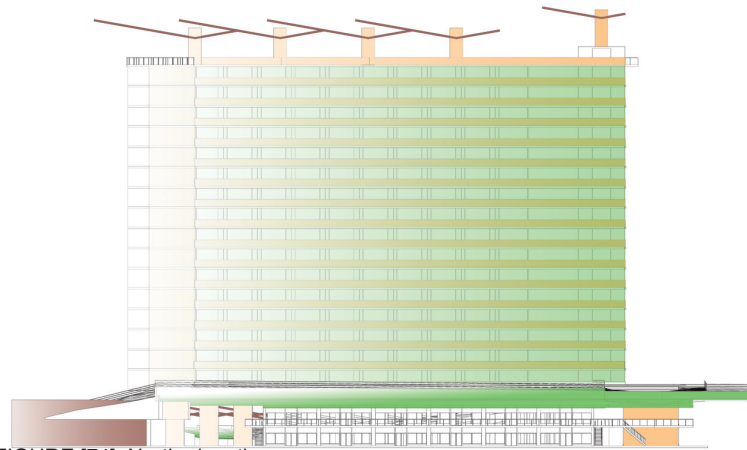


FIGURE [74] North elevation

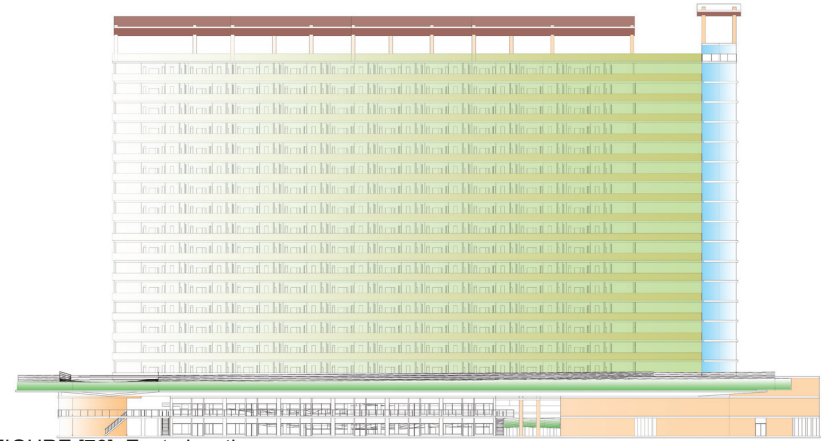


FIGURE [76] East elevation

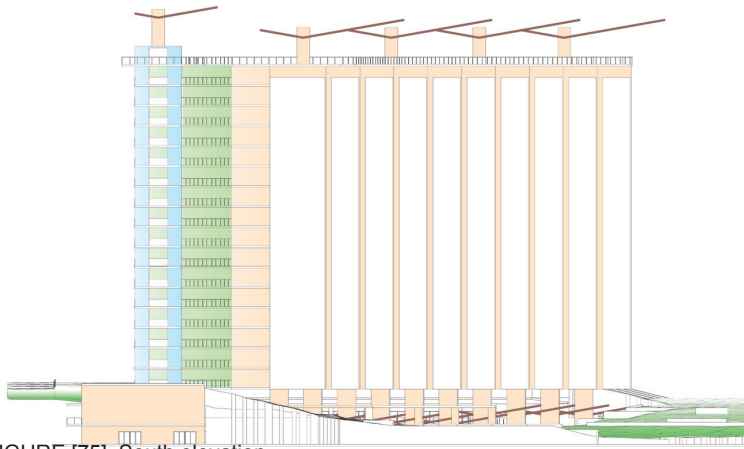


FIGURE [75] South elevation

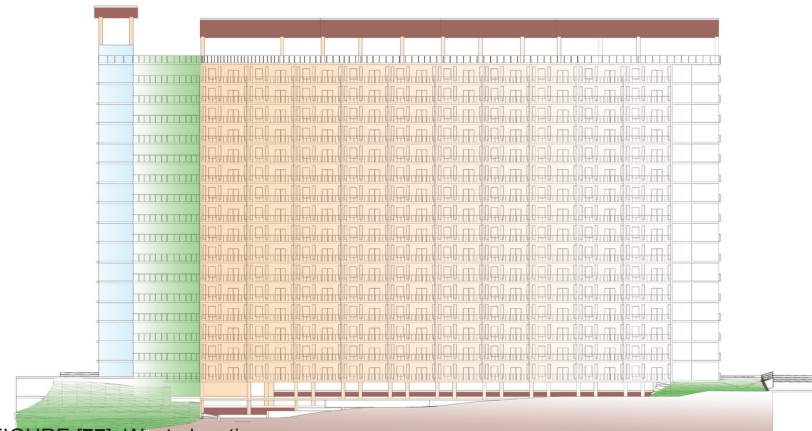
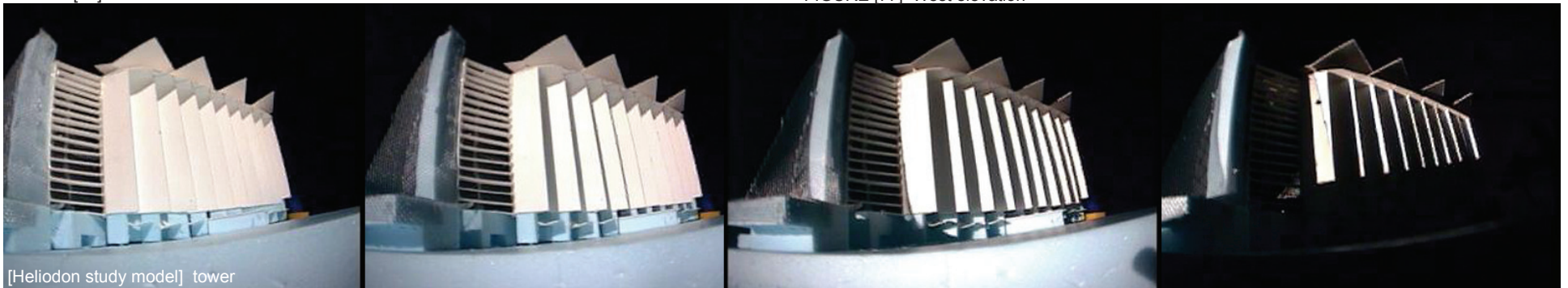


FIGURE [77] West elevation



[Heliodon study model] tower

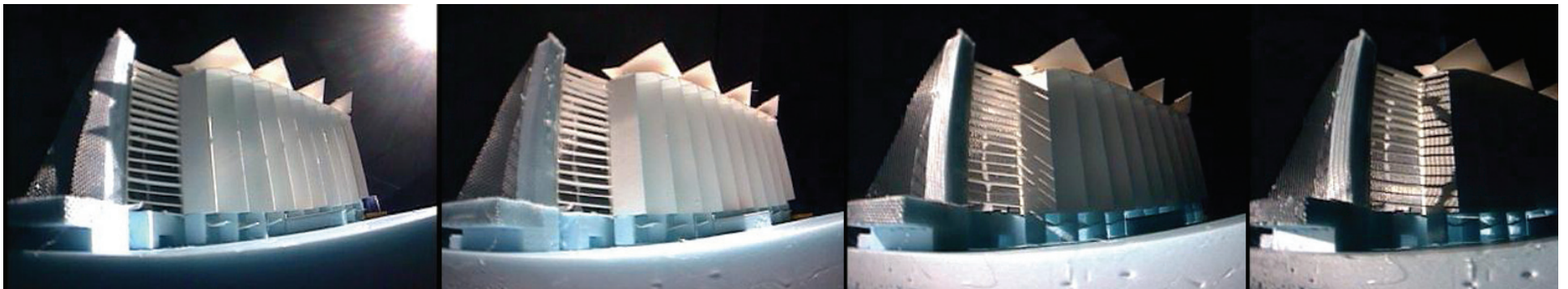
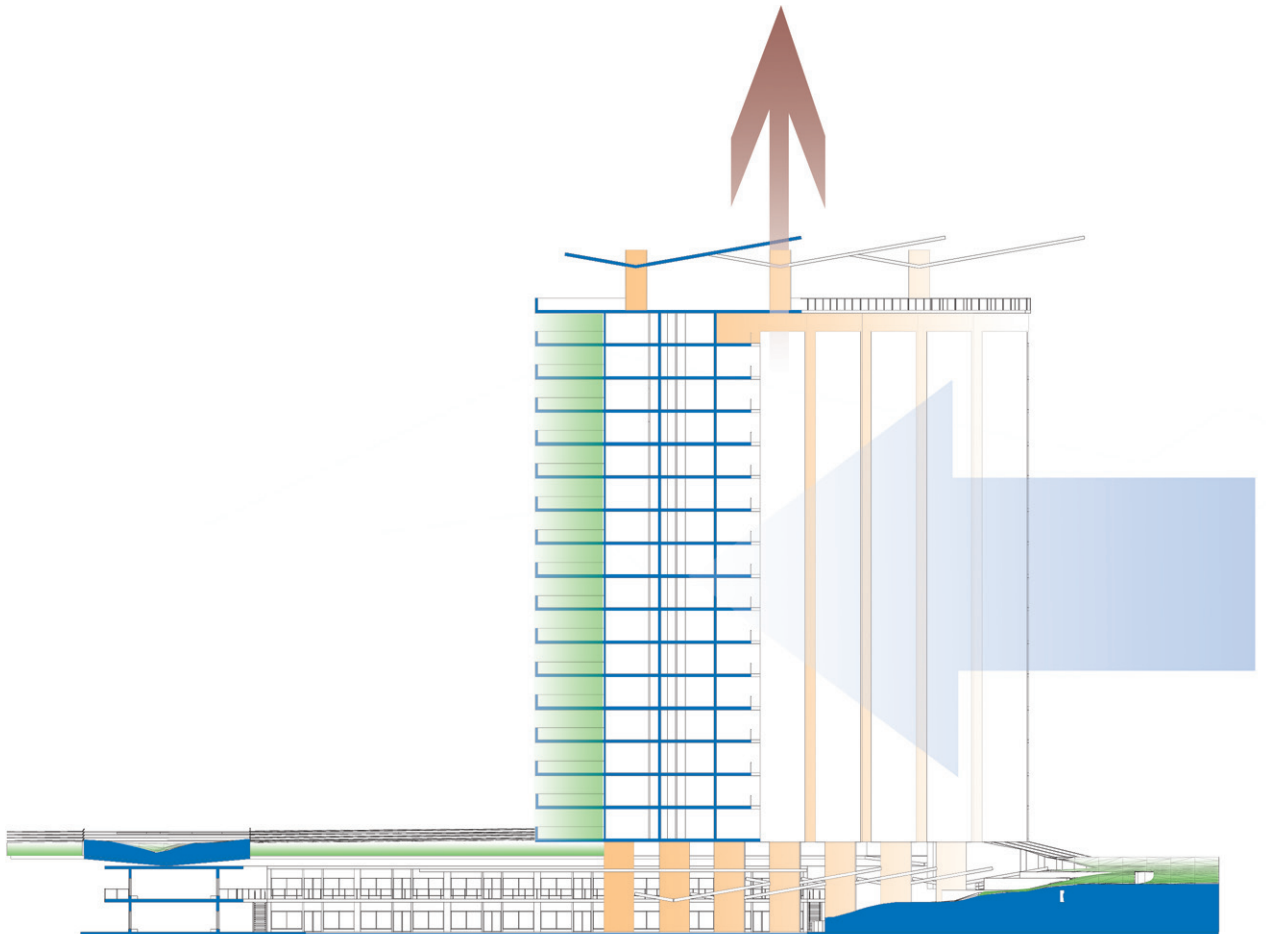


# [Sections]

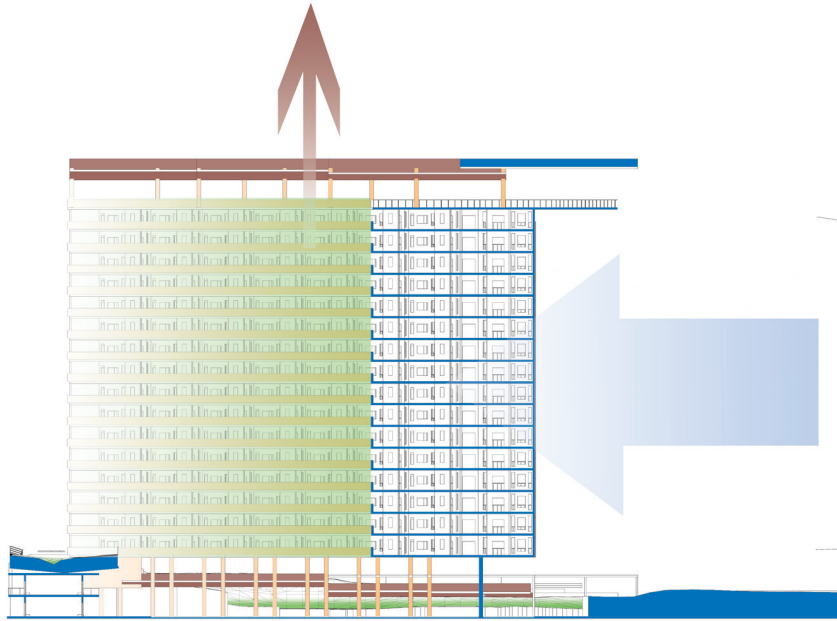
In this section, you can clearly see the single-loaded corridor that allows the cool ocean breeze pass through the balconies, then the living units, the on through the open air sky bridges. The deepened overhangs block direct sun penetrations.

The rooftop wings also direct wind like their smaller counterparts along the base of the building along the pedestrian paths. They are more useful than just wind diverters as well. Secondary uses include shade spaces for rooftop pedestrians, rain catchment systems for the westerly green wall, and finally creating a closing point to the tower as not the let the top the building float in space.

Along the south facade, the PV panels become very apparent. They are housed along the shear walls that serve as privacy walls, structure, and as stated before, help guide the macro climate wind into the living units.



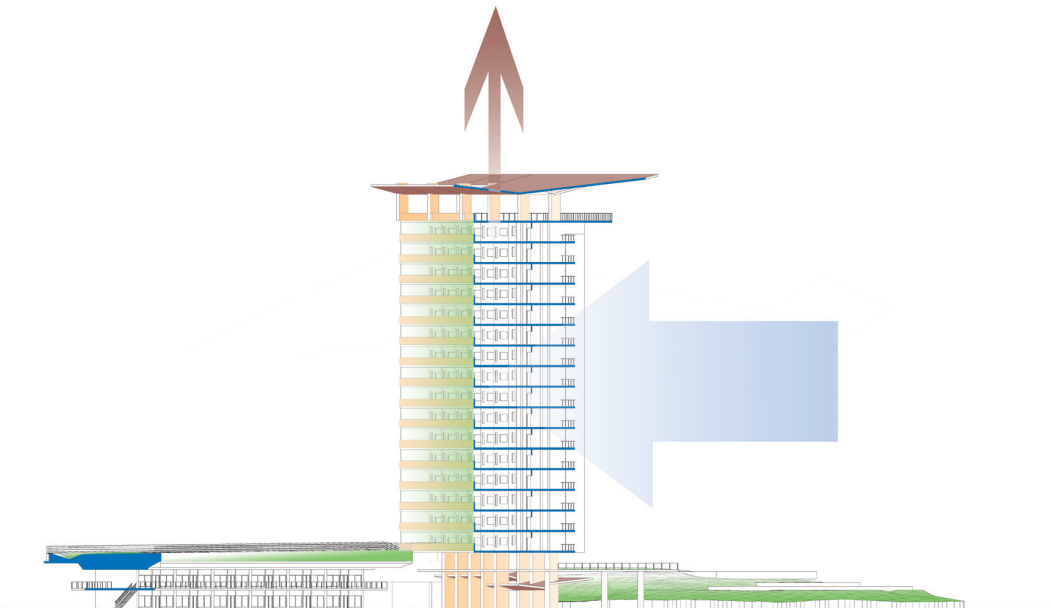
# [Sections]

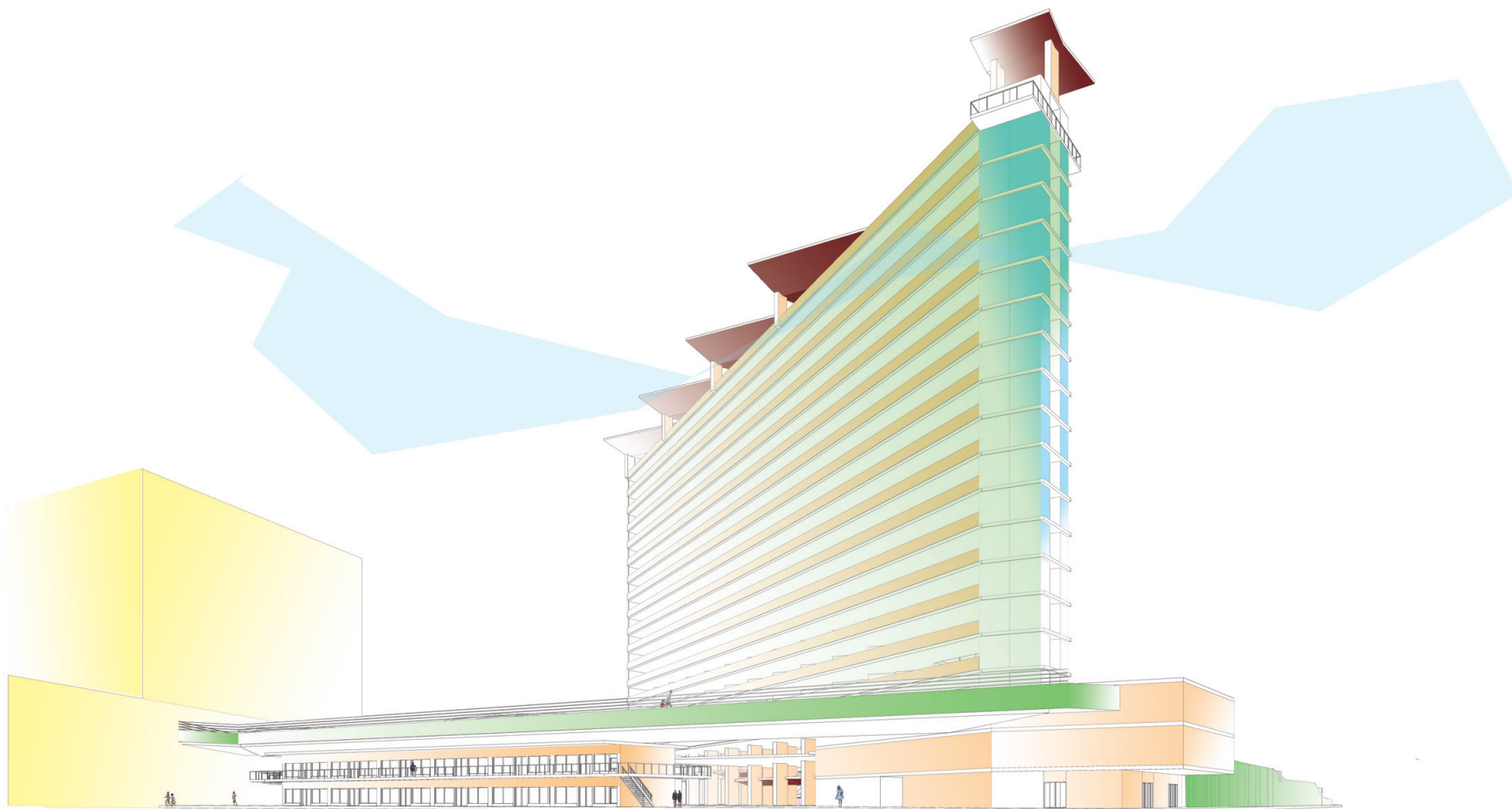


After the tower had conformed to my requirements of ventilation, the wholistic site planning had to be put in effect. I saw this resort as a series of stratum from below grade to the very rooftop. As the structure grows out of the ground, the columns create zones or pockets of pedestrian interaction. The main pedestrian circulation path is carved out of the park as the new park grows up from the beach entrance to the new pedestrian stratum. There then becomes three levels of public pedestrian interaction. Grade level where people on the beach flow through the site like the breeze off the ocean, then to the amphitheater park and the second level shops, then up to the third level where the removal of the ground level for shopping was places on the rooftop. The functionality of the green roof is not constrained to the limits of the park either. Sitting spaces, cafe's, small shops, and many other activities can happen on the roof which puts a whole new perspective on South Beach.

The other stratum occur to the resort tower users. Any-one that has a living unit at the resort has their own private sun deck with swimming pool, cafe, bar, and restaurant. The restaurant is separated by the structural columns that pierce through the sun deck and create more interaction pods. The restaurant is not restricted to people that have rented a space in the resort.

The rooftop deck is the upper level stratum the puts a finish on the tower. More bars and cafe's will be located on the roof along with another sun deck and has separation spaces by the structure that came up through the roof to fix the wind diverters to the building.









## [Designing a Elevated Park]



## [Through a Series of Stratum]

- Multiple level pedestrian interaction and location
- Public versus Private sectors
- Connection to ocean and retention of park
- Structural pockets for privacy

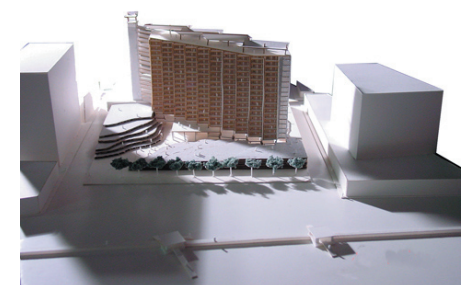
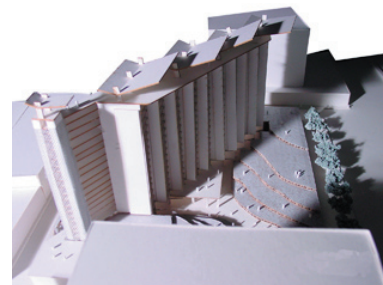
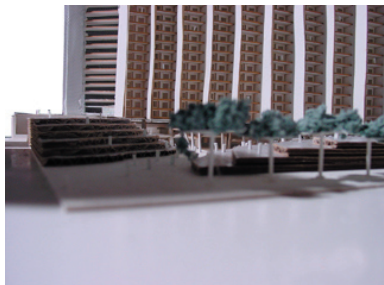
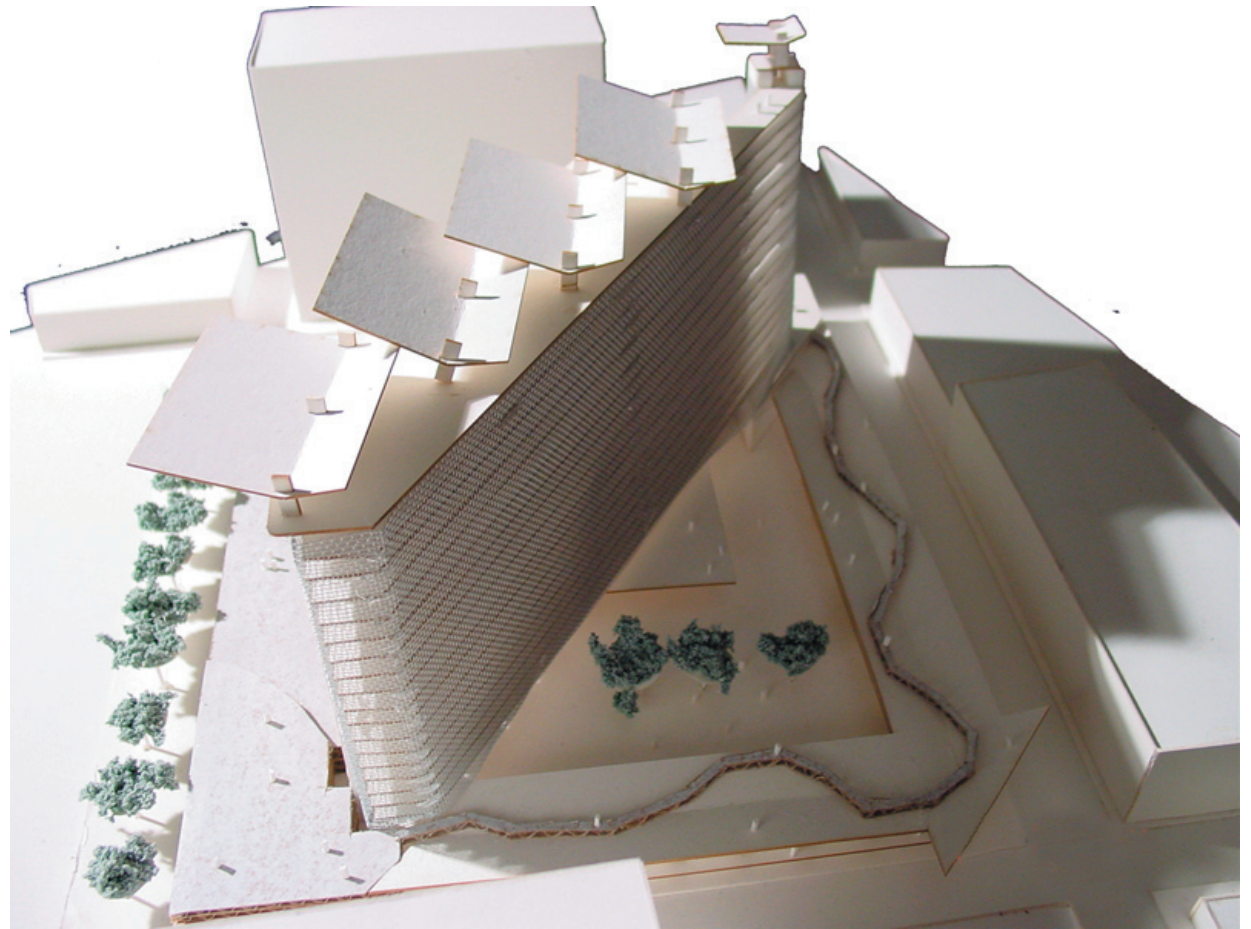




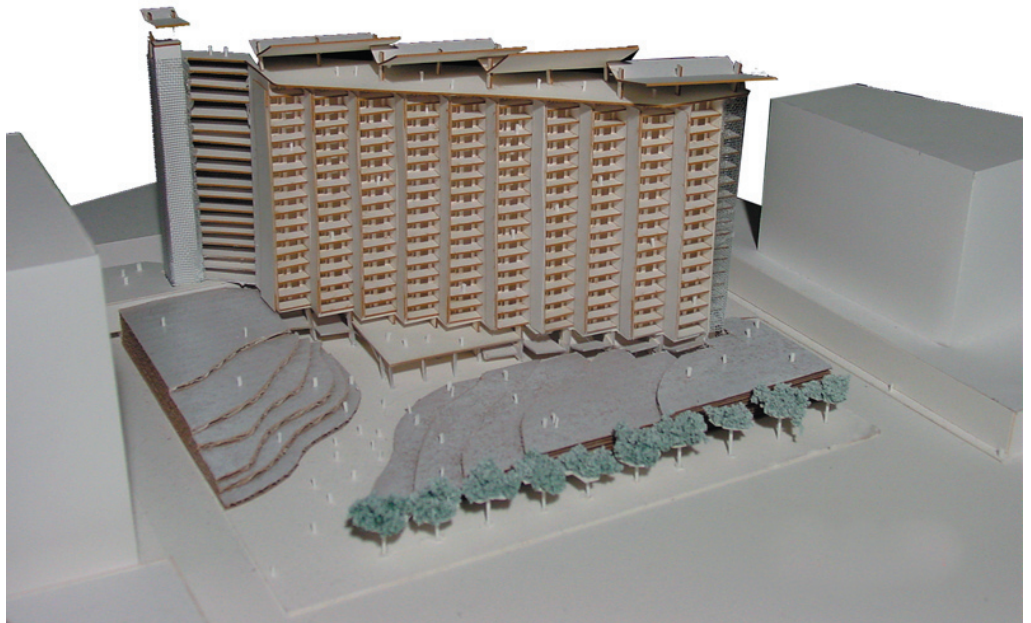
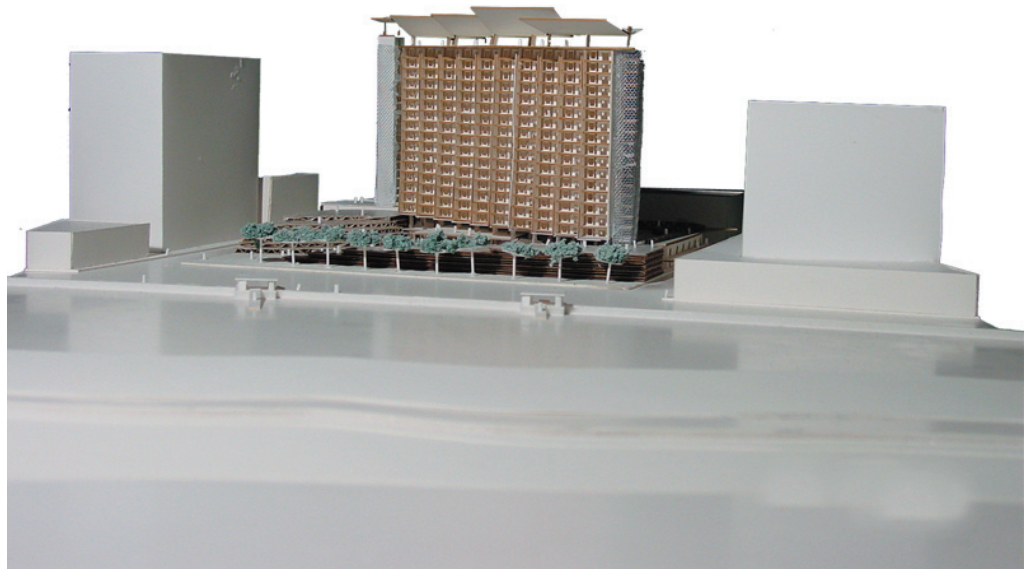
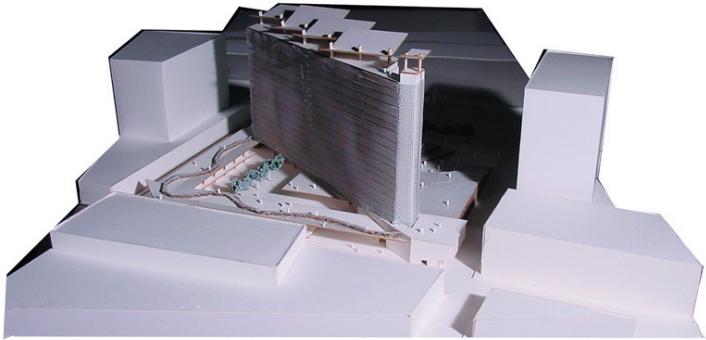


The model begins to make things clear to how Collins Park has been transformed into a energy saving building system. There is a fluidity about the different pieces and parts of the building starting from the ground up to the sky. Even though the functions of the for say, the retail roof and the tower roof are different, they both speak the same language as a series of dynamic parts. Another major accomplishment of the model is show by the shadows that are played out by the tower. The context and surroundings of Collins Park now all make sense and the building fits into the merging point of North Miami Beach and South Beach.

The building shadows shade the different parts of the complex at the best times as well. During the morning, the east side of the building is lit up by the sun, allowing beautiful reflections off the ocean shimmer into all of the living units. Waking up and watching the sun rise is only a few steps away. On the opposite side, the courtyard and retail spaces are under shadow, giving the pedestrians a cool place to enjoy brunch or do some shopping. As the sun heats up and moves around to the south, the green wall begins to protect the sky bridges from excessive heat gain. As the sun moves further to the west in the evening, neighboring buildings begin to shade the courtyard and retail center creating a great place to be.



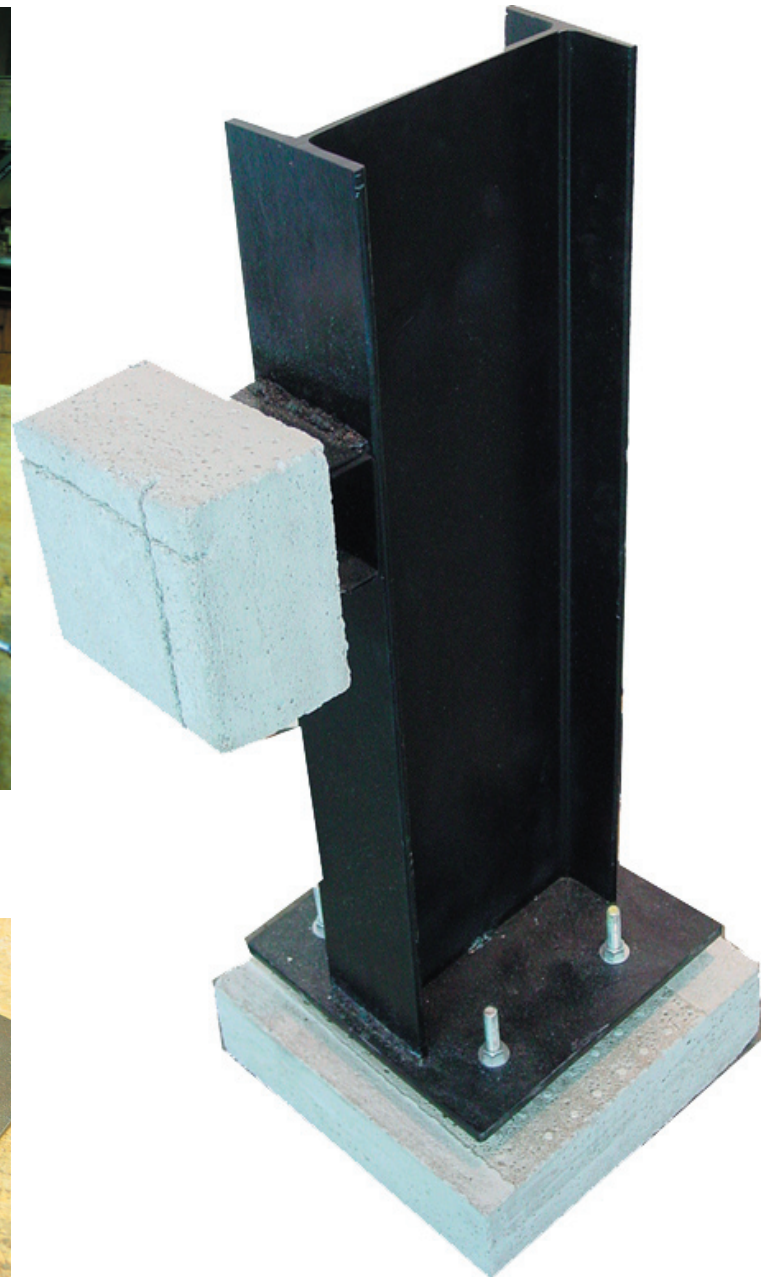
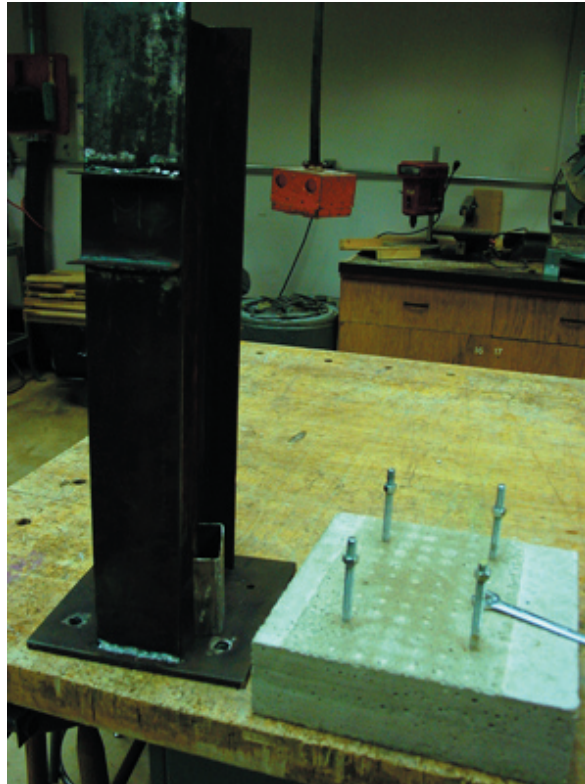






# [Structural Investigations]

This study was done to demonstrate and investigate precast concrete connections to a steel frame along with the connection from foundations to a base plate and steel column. All the steel was donated by Omni Source in downtown Muncie, IN. This was a very unique process from taking scrap metal, cutting it to square, preparing the surfaces for welding and finishing, and all the while, pouring a concrete base with anchor bolts. There are several ways to attach precast concrete systems to steel, but the manufactured systems are a lot more complex than what I had available. I used a pair of C-channels that were bolted to the small precast panel that were then welded to the steel column. This was a very difficult weld due to the large variation in the thickness of the two different steel parts. The welding of the steel baseplates or leveler plate was a lot simpler because of the similar thicknesses. After the welding was done and the concrete cured, it was a matter of bolting down the steel to the concrete and leveling it up.



# [Reflections and Bibliography]

This thesis endeavor has been a long and fruitful process. Developing ideas and testing them has brought this project a long way. I believe there are only two other items that I would like to investigate further, one being a bit more simple than the other. I'll start with the easiest one, and I believe this is just a minor fix that would need to happen. The structural members on the tower roof would need to be a continuous member of the existing structure that was defined by the base columns of the building. Right now, the columns that hold up the wind diverters do not work properly due to the wrong placement. Easy fix one!

Second is that east facade of the tower. Through jury reviews and further thinking, there was a need for a revision of the living area in each of the living units. The idea was to pull the wall at the living room out and allow that space to flow out to the edge of the balcony. This means that the living room would flow out and appear to have no terminus and merge with the ocean. The new facade could be a glass corner as to open the room up to the most views and light as possible. My only concern to that thought was intense heat gains through that corner glass. I think there is a type of glass that can defend against the radiation of the sun, so this schematic idea could very well work within this tower.

I think this semester has truly been a culmination of a college career in the College of Architecture and Planning. I held nothing back this semester and I think it has been my most successful year of school to date. I must thank Professor Bob Fisher again for his patience and knowledge, and for letting me explore my own ideas and helping me discover new ideas with constructive criticism.

I also want to thank all the peers in the studio, I think this year we have become that family that was always talked about in the beginning years. The incredible amount of talent has been fully revealed.

<http://greenbuildings.santa-monica.org/index.html>

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